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Model Year Start: 2023	**Model:** Prius Prime	**Prod Date Range:** [03/2023 -]
Title: M20A-FXS (ENGINE CONTROL): SFI SYSTEM: P042000; Catalyst System Efficiency Below Threshold Bank 1; 2023 - 2024 MY Prius Prius Prime [03/2023 -]		

DTC	**P042000**	**Catalyst System Efficiency Below Threshold Bank 1**

MONITOR DESCRIPTION

The ECM uses air fuel ratio 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 (sensor 1), sends pre-catalyst information to the ECM. The second sensor, the air fuel ratio sensor (sensor 2), sends post-catalyst information to the ECM.

In order to detect any deterioration in the three-way catalytic converter, the ECM calculates the oxygen storage capacity of the three-way catalytic converter. This calculation is based on the output current of the air fuel ratio sensor (sensor 2) while performing active air fuel ratio control.

The oxygen storage capacity value is an indication of the oxygen storage capacity of the three-way catalytic converter. When the vehicle is being driven with a warm engine, active air fuel ratio control is performed for approximately 30 seconds. When it is performed, the ECM deliberately sets the air fuel ratio to lean or rich levels. If the cycle of the waveform for the air fuel ratio sensor (sensor 2) is long, the oxygen storage capacity is great. There is a direct correlation between the air fuel ratio sensor (sensor 2) and the oxygen storage capacity of the three-way catalytic converter.

The ECM uses the oxygen storage capacity value to determine the state of the three-way catalytic converter. If any deterioration has occurred, the ECM will illuminate the MIL and store a DTC.

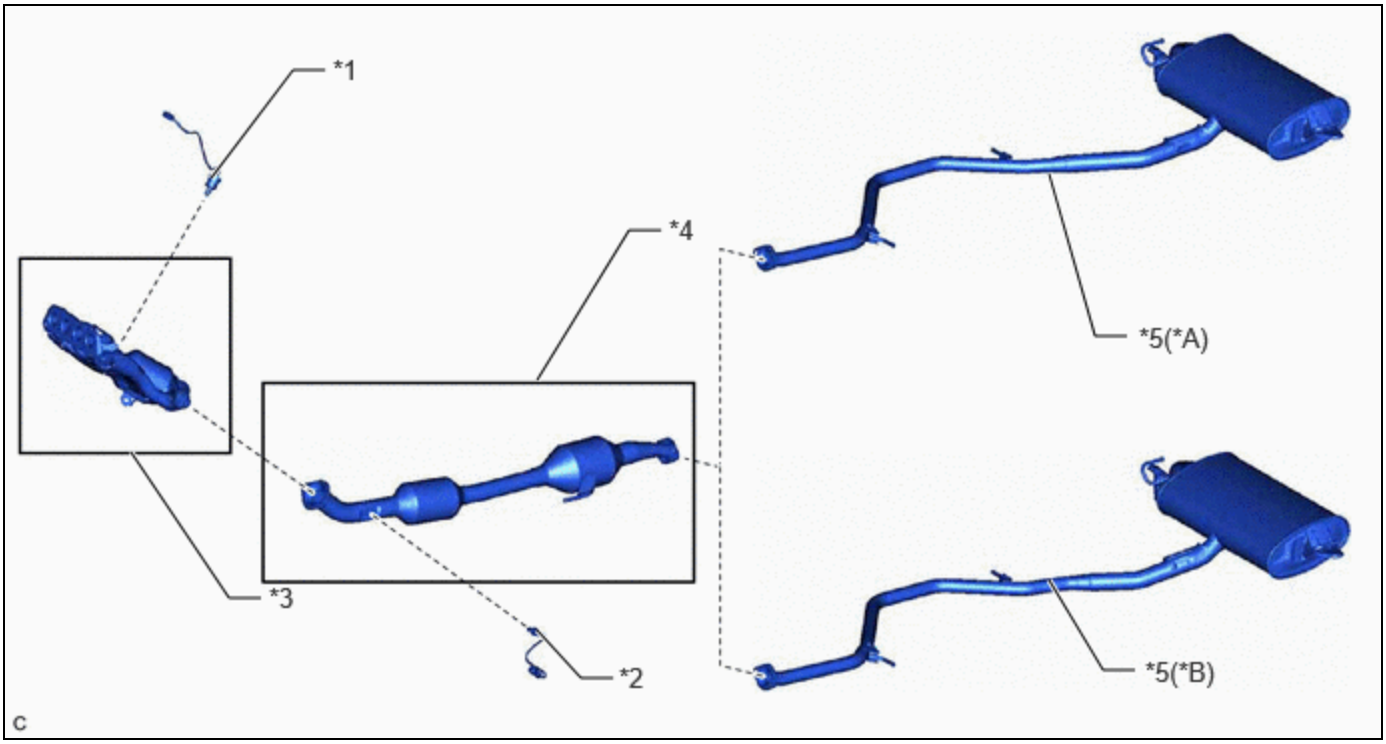
This system determines the deterioration of the entire catalyst system (including the front and rear catalysts), by using the oxygen storage capacity value of the front catalyst, that is more sensitive than the rear catalyst, as the representative value. Therefore, be sure to replace the front and rear catalysts together when catalyst replacement is necessary.

DTC NO.	DETECTION ITEM	DTC DETECTION CONDITION	TROUBLE AREA	MIL	DTC OUTPUT FROM	PRIORITY	NOTE
P042000	Catalyst System Efficiency Below Threshold Bank 1	The oxygen storage capacity value is less than the standard value under active air fuel ratio control (1 trip detection logic).	• Gas leak from exhaust system • Air fuel ratio sensor (sensor 1) • Air fuel ratio sensor (sensor 2) • Exhaust manifold (TWC: Front catalyst) • Front exhaust pipe	Comes on	Engine	B	SAE Code: P0420

DTC NO.	DETECTION ITEM	DTC DETECTION CONDITION	TROUBLE AREA	MIL	DTC OUTPUT FROM	PRIORITY	NOTE
			assembly (TWC: Rear catalyst) • EGR valve assembly				

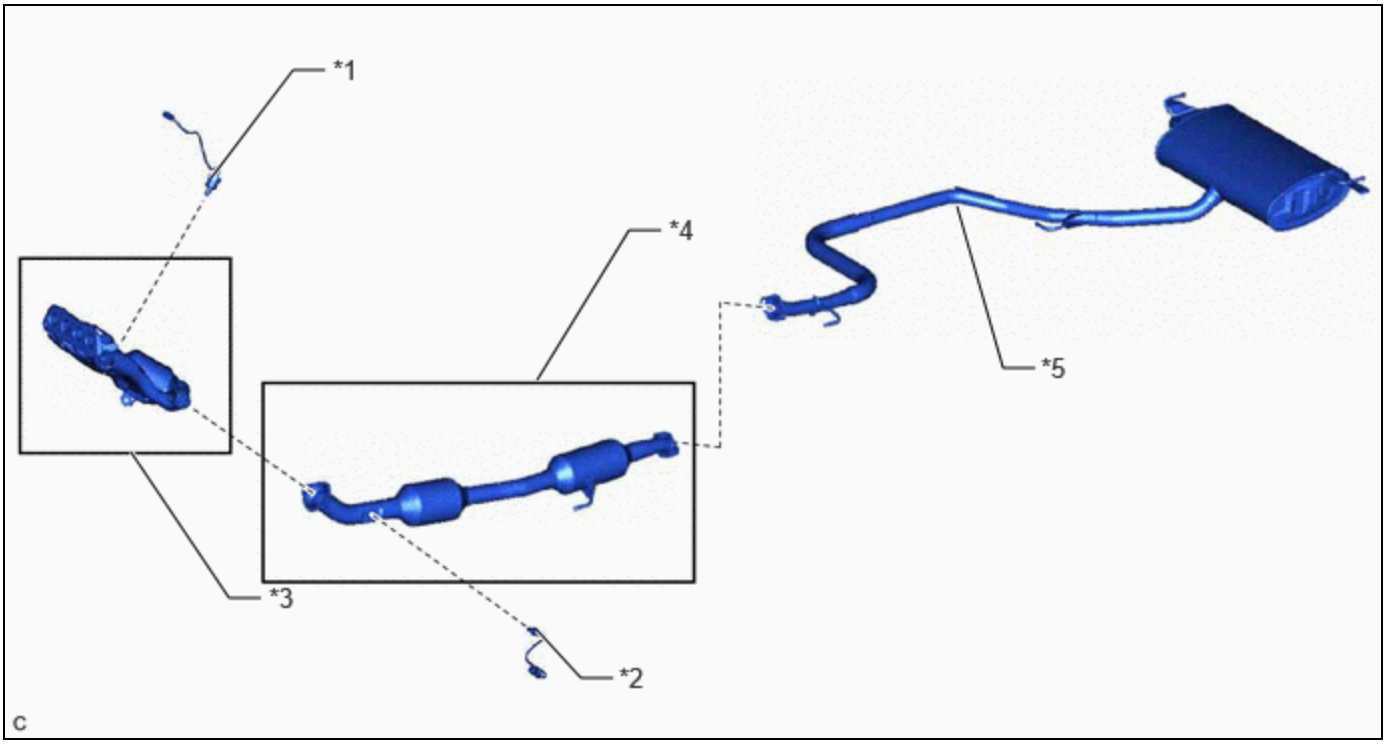
CATALYST LOCATION

for HEV Model



*A	for 2WD	*B	for 4WD
*1	Air Fuel Ratio Sensor (Sensor 1)	*2	Air Fuel Ratio Sensor (Sensor 2)
*3	Exhaust Manifold (TWC: Front Catalyst)	*4	Front Exhaust Pipe Assembly (TWC: Rear Catalyst)
*5	Tail Exhaust Pipe Assembly	-	-

for PHEV Model



*1	Air Fuel Ratio Sensor (Sensor 1)	*2	Air Fuel Ratio Sensor (Sensor 2)
*3	Exhaust Manifold (TWC: Front Catalyst)	*4	Front Exhaust Pipe Assembly (TWC: Rear Catalyst)
*5	Tail Exhaust Pipe Assembly	-	-

NOTICE:

When replacing the exhaust manifold (*3) and the front exhaust pipe assembly (*4) in order to replace the three-way catalytic converter, it is not necessary to replace the air fuel ratio sensor (sensor 1) (*1) and the air fuel ratio sensor (sensor 2) (*2).

MONITOR STRATEGY

Related DTCs	P0420: Catalyst deterioration
Required Sensors/Components (Main)	Air fuel ratio sensor (sensor 1) Air fuel ratio sensor (sensor 2)
Required Sensors/Components (Related)	Intake air temperature sensor Mass air flow meter sub-assembly Crankshaft position sensor Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	About 30 seconds
MIL Operation	1 driving cycle
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not stored	P0010, P1360, P1362, P1364, P1366, P2614 (Motor drive VVT system control module)

	P0011 (VVT system - advance) P0012 (VVT system - retard) P0013 (Exhaust VVT oil control solenoid) P0014 (Exhaust VVT system - advance) P0015 (Exhaust VVT system - retard) P0016 (VVT system - misalignment) P0017 (Exhaust VVT system - misalignment) P0031, P0032, P101D (Air fuel ratio sensor (sensor 1) heater) P0037, P0038, P102D (Air fuel ratio sensor (sensor 2) heater) P005D, P014C, P014D, P015A, P015B, P2195, P2196, P2237, P2238, P2239, P2252, P2253 (Air fuel ratio sensor (sensor 1)) P0087, P0088, P0191, P0192, P0193 (Fuel pressure sensor (for high pressure side)) P0101, P0102, P0103 (Mass air flow meter) P0106, P0107, P0108 (Manifold absolute pressure) P0112, P0113 (Intake air temperature sensor) P0116, P0117, P0118 (Engine coolant temperature sensor) P0121, P0122, P0123, P0222, P0223, P2135 (Throttle position sensor) P0125 (Insufficient coolant temperature for closed loop fuel control) P0128 (Thermostat) P0136, P013A, P2270, P2271, P22AB, P22AC, P22AD, P22B3, P22B4 (Air fuel ratio sensor (sensor 2)) P0171, P0172 (Fuel system) P0201, P0202, P0203, P0204, P062D, P21CF, P21D0, P21D1, P21D2 (Fuel injector) P0300, P0301, P0302, P0303, P0304 (Misfire) P0327, P0328 (Knock control sensor) P0335, P0337, P0338 (Crankshaft position sensor) P0340, P0342, P0343 (Camshaft position sensor) P0365, P0367, P0368 (Exhaust camshaft position sensor) P0401 (EGR system (closed)) P0489, P0490 (EGR control circuit) P0657, P0658, P2102, P2103, P2111, P2112, P2119 (Throttle actuator) P107B, P107C, P107D (Fuel pressure sensor (for low pressure side)) P11EA, P11EC, P11ED, P11EE, P11EF, P219A, P219C, P219D, P219E, P219F (Air-fuel ratio imbalance) P1235 (High pressure fuel pump circuit) P2228, P2229 (Atmospheric pressure sensor)
Response rate during fuel cut from rich condition	Completed
Auxiliary 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(abs) [11 psi(abs)] or higher
Idling	Off
Engine speed	Less than 4000 rpm
Sub feedback control	Executing

Air fuel ratio sensor (sensor 1) status	Activated
Fuel system status	Closed loop
Engine load	10% or higher, and less than 80%
All of the following conditions are met	1, 2 and 3
1. Mass air flow	2 gm/sec or more, and less than 40 gm/sec
2. Front catalyst temperature (estimated)	520°C (968°F) or higher, and less than 820°C (1508°F)
3. Rear catalyst temperature (estimated)	420°C (788°F) or higher, and less than 700°C (1292°F)

TYPICAL MALFUNCTION THRESHOLDS

Oxygen Storage Capacity (OSC) of catalyst (Normalized)	Less than 1

MONITOR RESULT

Refer to detailed information in Checking Monitor Status.

Click here INFO

P0420: Catalyst Efficiency / O2 STORAGE B1

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$21	$AF	Multiply by 0.001	No dimension	Oxygen storage capacity of catalyst bank 1 (Normalization)

CONFIRMATION DRIVING PATTERN

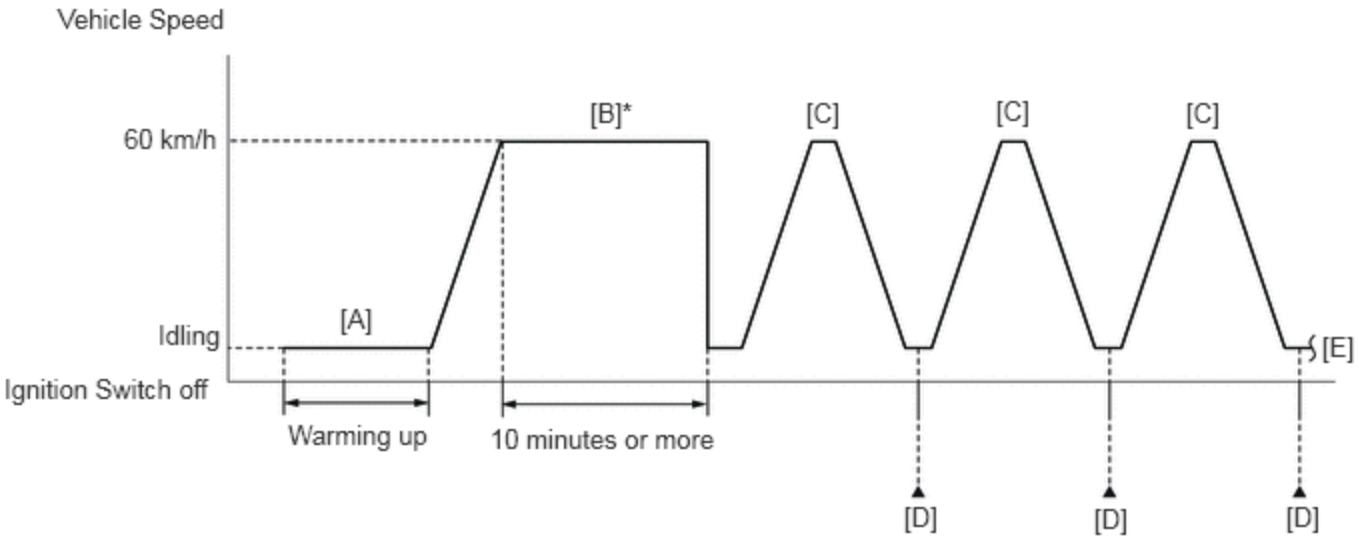
HINT:

- It is necessary for the response of the air fuel ratio sensor (sensor 2) to be normal in order to confirm DTC P042000. Therefore, perform the confirmation driving pattern for the air fuel ratio sensor (sensor 2) monitor before performing the confirmation driving pattern for the catalyst efficiency monitor.
- Performing this confirmation driving pattern will activate the catalyst efficiency monitor. This is very useful for verifying the completion of a repair.
- After repair has been completed, clear the DTC and then check that the vehicle has returned to normal by performing the following All Readiness check procedure.

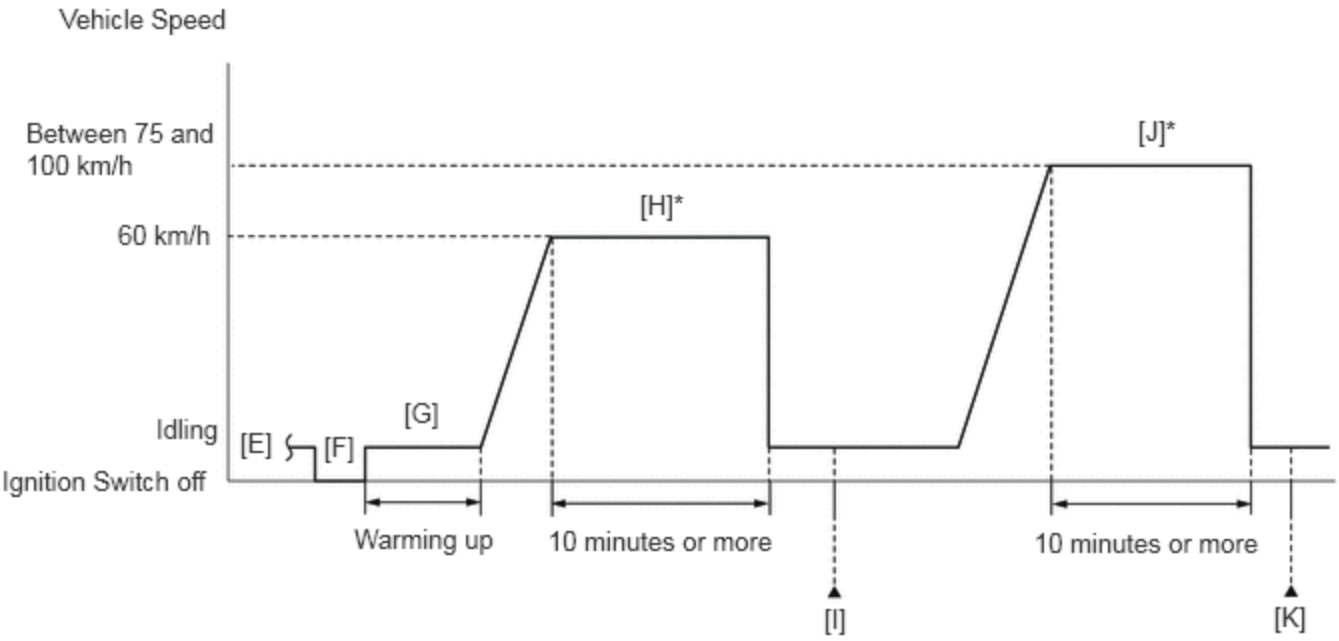
  Click here INFO
- When clearing the permanent DTCs, refer to the "CLEAR PERMANENT DTC" procedure.

  Click here INFO

Air Fuel Ratio Sensor (Sensor 2) Monitor Driving Pattern



Catalyst Efficiency Monitor Driving Pattern



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

1. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
2. Turn the ignition switch off and wait for at least 30 seconds.
3. Enter the following menus: Powertrain / Engine / Monitor / Current Monitor.
4. Check that Catalyst Efficiency / Current is Incomplete.
5. Start the engine and warm it up until the engine coolant temperature is 75°C (167°F) or higher with the shift lever in P [A].

HINT:

In order to keep the idle stable, turn the A/C and all other electric loads off and do not perform any shift operations.

6. Press the EV/HV mode selection switch to select HV mode. (for PHEV Model)

7. Drive the vehicle at approximately 60 km/h (37 mph) for 10 minutes or more [B].

CAUTION:

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

HINT:

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

8. With the shift lever in B, drive the vehicle at 60 km/h (37 mph), and then decelerate the vehicle by releasing the accelerator pedal for 5 seconds or more to perform the fuel-cut [C].

CAUTION:

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

9. Enter the following menus: Powertrain / Engine / Monitor / Current Monitor / O2 Sensor / Details / SLOW RESPONSE B1S2 [D].
10. Check the Test Value for SLOW RESPONSE B1S2.

HINT:

- If Test Value displays a value larger than 0, perform the following procedure, as the O2 Sensor monitor is finished.
- If Test Value displays 0, perform step [C] until it displays a value larger than 0, as the O2 Sensor monitor is not finished.

11. Turn the ignition switch off and wait for at least 30 seconds [F].
12. Start the engine and warm it up until the engine coolant temperature is 75°C (167°F) or higher [G].
13. Press the EV/HV mode selection switch to select HV mode. (for PHEV Model)
14. Drive the vehicle at approximately 60 km/h (37 mph) for 10 minutes or more [H].

CAUTION:

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

HINT:

- Drive the vehicle while keeping the engine load as constant as possible.
- The monitor item will change to Complete as the Catalyst Efficiency monitor operates.

15. Enter the following menus: Powertrain / Engine / Trouble Codes [I].
16. Check if any DTCs are stored.

HINT:

- If the monitor item does not change to Complete, and no DTCs are stored, perform the following procedure.
- [A] to [I]: Normal judgment procedure.

  The normal judgment procedure is used to complete DTC judgment and also used when clearing permanent DTCs.
- When clearing the permanent DTCs, do not disconnect the cable from the auxiliary battery terminal or attempt to clear the DTCs during this procedure, as doing so will clear the universal trip and normal judgment histories.

17. Drive the vehicle at a speed between 75 and 100 km/h (47 and 62 mph) for 10 minutes or more [J].

CAUTION:

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

HINT:

- Drive the vehicle while keeping the engine load as constant as possible.
- The monitor item will change to Complete as the Catalyst Efficiency monitor operates.

18. Enter the following menus: Powertrain / Engine / Trouble Codes [K].
19. Check if any DTCs are stored.

HINT:

If the monitor item does not change to Complete, and no DTCs are stored, extend the driving time.

20. Enter the following menus: Powertrain / Engine / Utility / All Readiness.
21. Input the DTC: P042000.
22. Check the DTC judgment result.

HINT:

- If the judgment result is NORMAL, the system is normal.
- If the judgment result is ABNORMAL, the system has a malfunction.
- [A] to [K]: Normal judgment procedure.

  The normal judgment procedure is used to complete DTC judgment and also used when clearing permanent DTCs.
- When clearing the permanent DTCs, do not disconnect the cable from the auxiliary battery terminal or attempt to clear the DTCs during this procedure, as doing so will clear the universal trip and normal judgment histories.

CAUTION / NOTICE / HINT

NOTICE:

- Vehicle Control History may be stored in the hybrid vehicle control ECU if the engine is malfunctioning. Certain vehicle condition information is recorded when Vehicle Control History is stored. Reading the vehicle conditions recorded in both the freeze frame data and Vehicle Control History can be useful for troubleshooting.

  for HEV Model: Click here INFO

  for PHEV Model: Click here INFO

  (Select Powertrain in Health Check and then check the time stamp data.)
- If any "Engine Malfunction" Vehicle Control History item has been stored in the hybrid vehicle control ECU, make sure to clear it. However, as all Vehicle Control History items are cleared simultaneously, if any Vehicle Control History items other than "Engine Malfunction" are stored, make sure to perform any troubleshooting for them before clearing Vehicle Control History.

  for HEV Model: Click here INFO

  for PHEV Model: Click here INFO

HINT:

- If a malfunction cannot be found when troubleshooting DTC P042000, a lean or rich abnormality may be the cause. Perform troubleshooting by following the inspection procedure for P017100 (System Too Lean) and P017200 (System Too Rich).
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

PROCEDURE

1.	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P042000)**

(a) Read the DTCs.

Powertrain > Engine > Trouble Codes

RESULT	PROCEED TO
P042000 and other DTCs are output	A

RESULT	PROCEED TO
P042000 is output	B

HINT:

If any DTCs other than P042000 are output, troubleshoot those DTCs first.

A ▶ **GO TO DTC CHART**

B

2.	**READ FREEZE FRAME DATA (LONG FT B1S2)**

(a) Using the GTS, read the value displayed in the Freeze Frame Data.

Powertrain > Engine > DTC(P042000) > Freeze Frame Data

TESTER DISPLAY
Long FT B1S2

RESULT	PROCEED TO
The value of Long FT B1S2 is less than 1.0 %	A
The value of Long FT B1S2 is 1.0 % or more	B

B ▶ **GO TO STEP 84**

A

3.	**PERFORM ACTIVE TEST USING GTS (CONTROL THE INJECTION VOLUME FOR A/F SENSOR)**

Pre-procedure1

(a) Put the engine in Inspection Mode (Maintenance Mode).

Powertrain > Hybrid Control > Utility

TESTER DISPLAY
Inspection Mode

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

Powertrain > Engine > Data List

TESTER DISPLAY
Coolant Temperature

(c) Idle the engine for 5 minutes or more with the shift lever in P.

Procedure1

(d) Change the fuel injection volume using the GTS, and monitor the output current of the air fuel ratio sensor (sensor 1) (A/F (O2) Sensor Current B1S1) and air fuel ratio sensor (sensor 2) (A/F (O2) Sensor Current B1S2) displayed on the GTS.

Powertrain > Engine > Active Test

ACTIVE TEST DISPLAY
Control the Injection Volume for A/F Sensor

DATA LIST DISPLAY
A/F (O2) Sensor Current B1S1
A/F (O2) Sensor Current B1S2

HINT:

- The Active Test "Control the Injection Volume for A/F Sensor" can be used to lower the fuel injection volume by 12.5% or increase the injection volume by 12.5%.
- The air fuel ratio sensor (sensor 1) is displayed as A/F (O2) Sensor Current B1S1, and the air fuel ratio sensor (sensor 2) is displayed as A/F (O2) Sensor Current B1S2 on the GTS.
- The air fuel ratio sensor (sensor 1) has an output delay of a few seconds and the air fuel ratio sensor (sensor 2) has a maximum output delay of approximately 20 seconds.
- If the sensor output current does not change (almost no reaction) while performing the Active Test, the sensor may be malfunctioning.

Standard:

GTS DISPLAY (SENSOR)	INJECTION VOLUME	STATUS	CURRENT
A/F (O2) Sensor Current B1S1 (Air fuel ratio (sensor 1))	12.5%	Rich	Below -0.075 mA
	-12.5%	Lean	More than 0.037 mA
A/F (O2) Sensor Current B1S2 (Air fuel ratio (sensor 2))	12.5%	Rich	Below -0.86 mA
	-12.5%	Lean	More than 0.33 mA

STATUS A/F (O2) SENSOR CURRENT B1S1	STATUS A/F (O2) SENSOR CURRENT B1S2	ACTUAL AIR FUEL RATIO, AIR FUEL RATIO SENSOR (SENSOR 1) AND AIR FUEL RATIO SENSOR (SENSOR 2) CONDITION	MAIN SUSPECTED TROUBLE AREA	PROCEED TO
Lean/Rich	Lean/Rich	Normal	• Three-way catalytic converter • Gas leak from exhaust system • EGR valve assembly	A
Lean	Lean/Rich	Air fuel ratio sensor (sensor 1) malfunction	• Air fuel ratio sensor (sensor 1)	B
Rich	Lean/Rich	Air fuel ratio sensor (sensor 1) malfunction	• Air fuel ratio sensor (sensor 1)	
Lean/Rich	Lean	Air fuel ratio sensor (sensor 2) malfunction	• Air fuel ratio sensor (sensor 2) • Gas leak from exhaust system	C
Lean/Rich	Rich	Air fuel ratio sensor (sensor 2) malfunction	• Air fuel ratio sensor (sensor 2) • Gas leak from exhaust system	
Lean	Lean	Actual air fuel ratio lean	• Extremely lean actual air fuel ratio • Gas leak from exhaust system • EGR valve assembly	D
Rich	Rich	Actual air fuel ratio rich	• Extremely rich actual air fuel ratio • Gas leak from exhaust system • EGR valve assembly	

Lean: During the Control the Injection Volume for A/F Sensor Active Test, the air fuel ratio sensor (sensor 1) output current (A/F (O2) Sensor Current B1S1) is consistently more than 0.037 mA, and the air fuel ratio sensor (sensor 2) output current (A/F (O2) Sensor Current B1S2) is consistently more than 0.33 mA.
Rich: During the Control the Injection Volume for A/F Sensor Active Test, the air fuel ratio sensor (sensor 1) output current (A/F (O2) Sensor Current B1S1) is consistently below -0.075 mA, and the air fuel ratio sensor (sensor 2) output current (A/F (O2) Sensor Current B1S2) is consistently below -0.86 mA.
Lean/Rich: During the Control the Injection Volume for A/F Sensor Active Test, the output current of the air fuel ratio sensor (sensor 1) or air fuel ratio sensor (sensor 2) alternates correctly.

HINT:

Refer to "Data List / Active Test" [A/F (O2) Sensor Current B1S1, A/F (O2) Sensor Current B1S2].

Click here INFO

Post-procedure1

(e) None.

B ▶ **GO TO STEP 7**

C ▶ **GO TO STEP 8**

D ▶ **GO TO STEP 10**

A ▼

4.	**CHECK FOR EXHAUST GAS LEAK**

(a) Check for exhaust gas leaks.

OK:

No gas leaks in exhaust system.

NG ▶ **GO TO STEP 80**

OK ▼

5.	**PERFORM ACTIVE TEST USING GTS (CONTROL THE EGR STEP POSITION)**

Pre-procedure1

(a) Put the engine in Inspection Mode (Maintenance Mode).

Powertrain > Hybrid Control > Utility

TESTER DISPLAY
Inspection Mode

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

Powertrain > Engine > Data List

TESTER DISPLAY
Coolant Temperature

HINT:

The A/C switch and all accessories should be off.

Procedure1

(c) Enter the following menus.

Powertrain > Engine > Active Test

ACTIVE TEST DISPLAY
Control the EGR Step Position

DATA LIST DISPLAY
Intake Manifold Absolute Pressure
Engine Independent

(d) Confirm that the value of Data List item Engine Independent is "Operate" then check the value of Intake Manifold Absolute Pressure while performing the Active Test.

NOTICE:

- Make sure that the value of Data List item Engine Independent is "Operate" while performing the Active Test.
- 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.
- Do not open the EGR valve 30 steps or more during the Active Test.

OK:

The value of Intake Manifold Absolute Pressure changes in response to the EGR step position when the value of Engine Independent is "Operate".

Standard:

-	CONTROL THE EGR STEP POSITION (ACTIVE TEST)	
	0 STEPS	0 TO 30 STEPS
Intake Manifold Absolute Pressure (Data List)	(EGR valve is fully closed)	Intake Manifold Absolute Pressure value is at least +10 kPa (1.45 psi) higher than when EGR valve is fully closed

HINT:

- If the value of Data List item Engine Independent is "Not Opr" when the engine is idling, charge control is being performed. Perform the Active Test after charge control is complete ("Operate" is displayed).
- While performing the Active Test, if the increase in the value of Intake Manifold Absolute Pressure is small, the EGR valve assembly may be malfunctioning.
- Even if the EGR valve assembly is malfunctioning, rough idling or an increase in the value of Intake Manifold Absolute Pressure may occur while performing the Active Test. However, the amount that the value of Intake Manifold Absolute Pressure increases will be smaller than normal.

RESULT	PROCEED TO
Intake Manifold Absolute Pressure value is at least +10 kPa (1.45 psi) higher than when EGR valve is fully closed	A
None of the above conditions are met	B

Post-procedure1

(e) None.

A ▶ **GO TO STEP 83**

B ▼

6.	**INSPECT EGR VALVE ASSEMBLY**

Pre-procedure1

(a) Remove the EGR valve assembly.

HINT:

Click here INFO

Procedure1

(b) Check if the EGR valve is stuck open.

OK:

EGR valve is tightly closed.

Post-procedure1

(c) None.

OK ▶ **GO TO STEP 83**

NG ▶ **REPLACE EGR VALVE ASSEMBLY**

7.	**REPLACE AIR FUEL RATIO SENSOR (SENSOR 1)**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

8.	**CHECK FOR EXHAUST GAS LEAK**

(a) Check for exhaust gas leaks.

OK:

No gas leaks in exhaust system.

NG ▶ **GO TO STEP 80**

OK ▼

9.	**REPLACE AIR FUEL RATIO SENSOR (SENSOR 2)**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

10.	**CHECK FOR EXHAUST GAS LEAK**

(a) Check for exhaust gas leaks.

OK:

No gas leaks in exhaust system.

NG ▶ **GO TO STEP 80**

OK ▼

11.	**PERFORM ACTIVE TEST USING GTS (CONTROL THE EGR STEP POSITION)**

Pre-procedure1

(a) Put the engine in Inspection Mode (Maintenance Mode).

Powertrain > Hybrid Control > Utility

TESTER DISPLAY
Inspection Mode

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

Powertrain > Engine > Data List

TESTER DISPLAY
Coolant Temperature

HINT:

The A/C switch and all accessories should be off.

Procedure1

(c) Confirm that the value of Data List item Engine Independent is "Operate" then check the value of Intake Manifold Absolute Pressure while performing the Active Test.

Powertrain > Engine > Active Test

ACTIVE TEST DISPLAY
Control the EGR Step Position

DATA LIST DISPLAY
Intake Manifold Absolute Pressure
Engine Independent

NOTICE:

- Make sure that the value of Data List item Engine Independent is "Operate" while performing the Active Test.
- 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.
- Do not open the EGR valve 30 steps or more during the Active Test.

OK:

The value of Intake Manifold Absolute Pressure changes in response to the EGR step position when the value of Engine Independent is "Operate".

Standard:

-	CONTROL THE EGR STEP POSITION (ACTIVE TEST)	
	0 STEPS	0 TO 30 STEPS
Intake Manifold Absolute Pressure (Data List)	(EGR valve is fully closed)	Intake Manifold Absolute Pressure value is at least +10 kPa (1.45 psi) higher than when EGR valve is fully closed

HINT:

- If the value of Data List item Engine Independent is "Not Opr" when the engine is idling, charge control is being performed. Perform the Active Test after charge control is complete ("Operate" is displayed).
- While performing the Active Test, if the increase in the value of Intake Manifold Absolute Pressure is small, the EGR valve assembly may be malfunctioning.
- Even if the EGR valve assembly is malfunctioning, rough idling or an increase in the value of Intake Manifold Absolute Pressure may occur while performing the Active Test. However, the amount that the value of Intake Manifold Absolute Pressure increases will be smaller than normal.

RESULT	PROCEED TO
Intake Manifold Absolute Pressure value is at least +10 kPa (1.45 psi) higher than when EGR valve is fully closed	A
None of the above conditions are met	B

Post-procedure1

(d) None.

A ▶ **GO TO STEP 13**

B ▼

12.	INSPECT EGR VALVE ASSEMBLY

Pre-procedure1

(a) Remove the EGR valve assembly.

HINT:

Click here INFO

Procedure1

(b) Check if the EGR valve is stuck open.

OK:

EGR valve is tightly closed.

Post-procedure1

(c) None.

NG ▶ **REPLACE EGR VALVE ASSEMBLY**

OK ▼

13.	**PERFORM ACTIVE TEST USING GTS (CONTROL THE INJECTION MODE)**

Click here INFO

ITEM		PROCEED TO
PORT	DIRECT	
OK	OK	A
OK	NG	B
NG	OK	C
NG	NG	D

B ▶ **GO TO STEP 17**

C ▶ **GO TO STEP 30**

D ▶ **GO TO STEP 33**

A ▼

14.	**CHECK IF VEHICLE HAS RUN OUT OF FUEL IN PAST**

Click here INFO

RESULT	PROCEED TO
YES	A
NO	B

B GO TO STEP 16

A

15.	DTC CAUSED BY RUNNING OUT OF FUEL

(a) DTC caused by running out of fuel.

NEXT GO TO STEP 81

16.	CHECK FOR INTERMITTENT PROBLEMS

HINT:

Click here INFO

NEXT GO TO STEP 81

17.	READ VALUE USING GTS (FUEL PRESSURE (HIGH))

Click here INFO

RESULT	PROCEED TO
The value of Fuel Pressure (High) is between 3000 and 25000 kPag	A
None of the above conditions are met	B

B GO TO STEP 24

A

18.	PERFORM ACTIVE TEST USING GTS (CONTROL THE INJECTION MODE (DIRECT))

Click here INFO

ITEM			PROCEED TO
INJECTION MODE	HIGH PRESSURE FUEL PUMP DUTY RATIO (D4)	TOTAL OF SHORT FT B1S1 AND LONG FT B1S1	
Direct	10% to 50%	-	A
	50% or higher	-20% or less	B
	10% or less	+20% or higher	
	50% or higher	+20% or higher	C
	10% or less	-20% or less	D

B ▶ **GO TO STEP 22**

C ▶ **GO TO STEP 25**

D ▶ **GO TO STEP 23**

A ▼

19.	**PERFORM ACTIVE TEST USING GTS (CONTROL THE INJECTION MODE (DIRECT))**

Click here INFO

ITEM			PROCEED TO
INJECTION MODE	HIGH PRESSURE FUEL PUMP DUTY RATIO (D4)	TOTAL OF SHORT FT B1S1 AND LONG FT B1S1	
Direct	10 to 50%	-25% or less	A
	10 to 50%	+25% or higher	
	10 to 50%	-25 to +25%	B

B ▶ **GO TO STEP 21**

A ▼

20.	**REPLACE DIRECT FUEL INJECTOR ASSEMBLY**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

21.	**CHECK FOR INTERMITTENT PROBLEMS**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

22.	**REPLACE FUEL PRESSURE SENSOR (FOR HIGH PRESSURE SIDE)**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

23.	**REPLACE ECM**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

24.	**CHECK MISFIRE COUNT OF DIRECT INJECTION**

Click here INFO

INJECTION MODE	MISFIRE COUNT	PROCEED TO
Direct	No misfire counts, or misfire counts occur randomly in all cylinders	A
	Misfire counts occur in particular cylinder	B

B ▶ **GO TO STEP 28**

A

25.	**REPLACE FUEL (ENGINE ROOM SIDE) PUMP ASSEMBLY (FOR HIGH PRESSURE SIDE)**

Click here INFO

NEXT

26.	**CLEAR DTC**

Click here INFO

NEXT

27.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P042000)**

Pre-procedure1

(a) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

Procedure1

(b) Check that the DTC judgment result is NORMAL. If the DTC judgment result is INCOMPLETE, perform the confirmation drive pattern again but increase the vehicle speed.

Powertrain > Engine > Utility

TESTER DISPLAY
All Readiness

(c) Input the DTC: P042000.

RESULT	PROCEED TO
NORMAL (DTCs are not output)	A
ABNORMAL (DTC P042000 is output)	B

Post-procedure1

(d) None.

A ▶ **GO TO STEP 81**

B ▶ **GO TO STEP 29**

28.	**REPLACE DIRECT FUEL INJECTOR ASSEMBLY**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

29.	**REPLACE ECM**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

30.	**INSPECT PORT FUEL INJECTOR ASSEMBLY**

Click here INFO

NG ▶ **GO TO STEP 32**

OK ▼

31.	**REPLACE ECM**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

32.	**REPLACE PORT FUEL INJECTOR ASSEMBLY**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

33.	**CHECK PCV VALVE AND HOSE CONNECTIONS**

Click here INFO

NG ▶ **GO TO STEP 79**

OK ▼

34.	**CHECK INTAKE SYSTEM**

Click here INFO

NG ▶ **GO TO STEP 78**

OK ▼

35.	**PERFORM ACTIVE TEST USING GTS (CONTROL THE INJECTION VOLUME FOR A/F SENSOR)**

Click here INFO

STATUS A/F (O2) SENSOR CURRENT B1S1	STATUS A/F (O2) SENSOR CURRENT B1S2	AIR FUEL RATIO CONDITION AND AIR FUEL RATIO SENSOR CONDITION	SUSPECTED TROUBLE AREA	PROCEED TO
Lean/Rich	Lean/Rich	Normal	-	A
Lean	Lean	Actual air fuel ratio lean	• PCV valve and hose • PCV hose connections • Gas leak from exhaust system • Intake system • Fuel pressure • Mass air flow meter sub-assembly	

STATUS A/F (O2) SENSOR CURRENT B1S1	STATUS A/F (O2) SENSOR CURRENT B1S2	AIR FUEL RATIO CONDITION AND AIR FUEL RATIO SENSOR CONDITION	SUSPECTED TROUBLE AREA	PROCEED TO
			• Engine coolant temperature sensor • EGR valve assembly	
Rich	Rich	Actual air fuel ratio rich	• Gas leak from exhaust system • Ignition system • Fuel pressure • Mass air flow meter sub-assembly • Engine coolant temperature sensor • EGR valve assembly	
Lean	Lean/Rich	Air fuel ratio sensor (sensor 1) malfunction	• Air fuel ratio sensor (sensor 1)	B
Rich	Lean/Rich	Air fuel ratio sensor (sensor 1) malfunction	• Air fuel ratio sensor (sensor 1)	

B ▶ **GO TO STEP 51**

A

▼

36.	**READ VALUE USING GTS (COOLANT TEMPERATURE)**

Click here INFO

NG ▶ **GO TO STEP 50**

OK

▼

37.	**PERFORM ACTIVE TEST USING GTS (CONTROL THE EGR STEP POSITION)**

Click here INFO

RESULT	PROCEED TO
Intake Manifold Absolute Pressure value is at least +10 kPa (1.45 psi) higher than when EGR valve is fully closed	A
None of the above conditions are met	B

A ▶ **GO TO STEP 39**

B

38.	**INSPECT EGR VALVE ASSEMBLY**

Click here INFO

NG ▶ **GO TO STEP 49**

OK

39.	**READ VALUE USING GTS (MASS AIR FLOW SENSOR)**

Click here INFO

RESULT	PROCEED TO
The value of Mass Air Flow Sensor is between 5.5 and 18.6 gm/sec	A
None of the above conditions are met	B

B ▶ **GO TO STEP 59**

A

40.	**CHECK FUEL PRESSURE (FOR LOW PRESSURE SIDE)**

Click here INFO

NG ▶ **GO TO STEP 46**

OK
▼

41.	**CHECK FOR EXHAUST GAS LEAK**

Click here INFO

NG ▶ **GO TO STEP 45**

OK
▼

42.	**INSPECT SPARK PLUG**

Click here INFO

NG ▶ **GO TO STEP 44**

OK
▼

43.	**CHECK FOR SPARK (SPARK TEST)**

Click here INFO

NEXT ▶ **GO TO STEP 59**

44.	**REPLACE SPARK PLUG**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

45.	**REPAIR OR REPLACE EXHAUST SYSTEM**

(a) Repair or replace exhaust system.

NEXT ▶ **GO TO STEP 81**

46.	**CHECK FUEL LINE**

Click here INFO

NG ▶ **GO TO STEP 48**

OK ▼

47.	**GO TO FUEL PUMP CONTROL CIRCUIT**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

48.	**REPAIR OR REPLACE FUEL SYSTEM**

(a) Repair or replace fuel system.

NEXT ▶ **GO TO STEP 81**

49.	**REPLACE EGR VALVE ASSEMBLY**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

50.	**REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

51.	**INSPECT AIR FUEL RATIO SENSOR (SENSOR 1) (HEATER RESISTANCE)**

Click here INFO

NG ▶ **GO TO STEP 77**

OK ▼

52.	**CHECK TERMINAL VOLTAGE (POWER SOURCE OF AIR FUEL RATIO SENSOR (SENSOR 1))**

Click here INFO

NG ▶ **GO TO STEP 62**

OK ▼

53.	**CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR (SENSOR 1) - ECM)**

Click here INFO

NG ▶ **GO TO STEP 57**

OK ▼

54.	**REPLACE AIR FUEL RATIO SENSOR (SENSOR 1)**

Click here INFO

NEXT

55.	**CLEAR DTC**

Click here INFO

NEXT

56.	**CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED**

Pre-procedure1

(a) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

Procedure1

(b) Read the DTCs.

Powertrain > Engine > Trouble Codes

RESULT	PROCEED TO
DTCs are not output	A
P042000 is output	B

Post-procedure1

(c) None.

A ▶ **GO TO STEP 81**

B ▶ **GO TO STEP 58**

57.	**REPAIR OR REPLACE HARNESS OR CONNECTOR**

(a) Repair or replace harness or connector.

NEXT ▶ **GO TO STEP 81**

58.	**READ VALUE USING GTS (MASS AIR FLOW SENSOR)**

Click here INFO

NEXT

59.	**CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER SUB-ASSEMBLY CONNECTOR CONNECTION)**

Click here INFO

NEXT

60.	**CLEAR DTC**

Click here INFO

NEXT

61.	**CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED**

Pre-procedure1

(a) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

Procedure1

(b) Read the DTCs.

Powertrain > Engine > Trouble Codes

RESULT	PROCEED TO
DTCs are not output	A
P042000 is output	B

Post-procedure1

(c) None.

A ▶ **GO TO STEP 81**

B ▶ **GO TO STEP 67**

62.	**INSPECT EFI-MAIN NO. 2 RELAY**

Click here INFO

NG ▶ **GO TO STEP 76**

OK ▼

63.	**CHECK TERMINAL VOLTAGE (POWER SOURCE OF EFI-MAIN NO. 2 RELAY)**

Click here INFO

NG ▶ **GO TO STEP 75**

OK ▼

64.	**CHECK HARNESS AND CONNECTOR (EFI-MAIN NO. 2 RELAY - BODY GROUND)**

Click here INFO

NG ▶ **GO TO STEP 74**

OK ▼

65.	**CHECK HARNESS AND CONNECTOR (EFI-MAIN NO. 2 RELAY - AIR FUEL RATIO SENSOR (SENSOR 1))**

Click here INFO

NG ▶ **GO TO STEP 71**

OK ▼

66.	**REPAIR OR REPLACE HARNESS OR CONNECTOR (EFI-MAIN NO. 1 RELAY - EFI-MAIN NO. 2 RELAY)**

(a) Repair or replace harness or connector (EFI-MAIN No. 1 relay - EFI-MAIN No. 2 relay).

NEXT ▶ **GO TO STEP 81**

67.	**CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER SUB-ASSEMBLY - ECM)**

Click here INFO

NG ▶ **GO TO STEP 72**

OK ▼

68.	**INSPECT MASS AIR FLOW METER SUB-ASSEMBLY**

Click here INFO

NEXT ▼

69.	**CLEAR DTC**

Click here INFO

NEXT ▼

70.	**CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED**

Pre-procedure1

(a) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

Procedure1

(b) Read the DTCs.

Powertrain > Engine > Trouble Codes

RESULT	PROCEED TO
DTCs are not output	A
P042000 is output	B

Post-procedure1

(c) None.

A ▶ **GO TO STEP 81**

B ▶ **GO TO STEP 73**

71.	**REPAIR OR REPLACE HARNESS OR CONNECTOR**

(a) Repair or replace harness or connector.

NEXT ▶ **GO TO STEP 81**

72.	**REPAIR OR REPLACE HARNESS OR CONNECTOR**

(a) Repair or replace harness or connector.

NEXT ▶ **GO TO STEP 81**

73.	**REPLACE ECM**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

74.	**REPAIR OR REPLACE HARNESS OR CONNECTOR**

(a) Repair or replace harness or connector.

NEXT ▶ **GO TO STEP 81**

75.	**REPAIR OR REPLACE HARNESS OR CONNECTOR (AUXILIARY BATTERY - EFI-MAIN NO. 2 RELAY)**

(a) Repair or replace harness or connector (auxiliary Battery - EFI-MAIN No. 2 relay).

NEXT ▶ **GO TO STEP 81**

76.	**REPLACE EFI-MAIN NO. 2 RELAY**

(a) Replace EFI-MAIN No. 2 relay.

NEXT ▶ **GO TO STEP 81**

77.	**REPLACE AIR FUEL RATIO SENSOR (SENSOR 1)**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

78.	**REPAIR OR REPLACE INTAKE SYSTEM**

(a) Repair or replace intake system.

NEXT ▶ **GO TO STEP 81**

79.	**REPAIR OR REPLACE PCV VALVE OR HOSE**

(a) Repair or replace PCV valve or hose.

NEXT ▶ **GO TO STEP 81**

80.	**REPAIR OR REPLACE EXHAUST SYSTEM**

HINT:

Perform "Inspection After Repair" after repairing or replacing the exhaust system.

Click here INFO

NEXT

81.	**CLEAR DTC**

Pre-procedure1

(a) None.

Procedure1

(b) Clear the DTCs.

Powertrain > Engine > Clear DTCs

Post-procedure1

(c) Turn the ignition switch off and wait for at least 30 seconds.

NEXT

82.	**CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED**

Pre-procedure1

(a) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

Procedure1

(b) Read the DTCs.

Powertrain > Engine > Trouble Codes

RESULT	PROCEED TO
DTCs are not output	A
P042000 is output	B

Post-procedure1

(c) None.

A **END**

B

83.	**REPLACE EXHAUST MANIFOLD (TWC: FRONT CATALYST) AND FRONT EXHAUST PIPE ASSEMBLY (TWC: REAR CATALYST)**

NOTICE:

When replacing the exhaust manifold and the front exhaust pipe assembly in order to replace the three-way catalytic converter, it is not necessary to replace the air fuel ratio sensor (sensor 1) and the air fuel ratio sensor (sensor 2).

HINT:

Confirm the replacement parts, referring to the illustration in the Catalyst Location.

(a) Replace the exhaust manifold (TWC: Front catalyst).

HINT:

Click here INFO

(b) Replace the front exhaust pipe assembly (TWC: Rear catalyst).

HINT:

Click here INFO

NEXT **END**

84.	**CHECK FOR EXHAUST GAS LEAK**

OK:

No gas leaks in exhaust system.

HINT:

Perform "Inspection After Repair" after repairing or replacing the exhaust system.

Click here INFO

NG **REPAIR OR REPLACE EXHAUST SYSTEM**

OK

85.	**REPLACE AIR FUEL RATIO SENSOR (SENSOR 2)**

HINT:

Click here INFO

NEXT

86.	CLEAR DTC

Pre-procedure1

(a) None.

Procedure1

(b) Clear the DTCs.

Powertrain > Engine > Clear DTCs

Post-procedure1

(c) Turn the ignition switch off and wait for at least 30 seconds.

NEXT

87.	CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

Pre-procedure1

(a) Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.

Procedure1

(b) Check for DTCs.

Powertrain > Engine > Trouble Codes

DTCs are not output.

Post-procedure1

(c) None.

NEXT **END**