Last Modified: 12-04-2024	6.11:8.1.0	**Doc ID:** RM100000002BLVD
Model Year Start: 2023	**Model:** Prius Prime	**Prod Date Range:** [03/2023 -]
Title: M20A-FXS (ENGINE CONTROL): SFI SYSTEM: P013616,P013A7C; A/F (O2) Sensor Circuit Bank 1 Sensor 2 Circuit Current (Voltage) Below Threshold; 2023 - 2024 MY Prius Prius Prime [03/2023 -]		

DTC	**P013616**	**A/F (O2) Sensor Circuit Bank 1 Sensor 2 Circuit Current (Voltage) Below Threshold**

DTC	**P013A7C**	**A/F Sensor - Rich to Lean Bank 1 Sensor 2 Slow Response**

DESCRIPTION

Refer to DTC P003612.

Click here INFO

HINT:

Although the DTC title says O2 sensor, this DTC relates to the air fuel ratio sensor (sensor 2).

DTC NO.	DETECTION ITEM	DTC DETECTION CONDITION	TROUBLE AREA	MIL	DTC OUTPUT FROM	PRIORITY	NOTE
P013616	A/F (O2) Sensor Circuit Bank 1 Sensor 2 Circuit Current (Voltage) Below Threshold	Either of the following conditions is met (2 trip detection logic). • During active rich air-fuel ratio control, the air fuel ratio sensor (sensor 2) current is 6 mA or more • During active rich air-fuel ratio control, the oxygen storage capacity of the catalyst is more than 2 g when the air fuel ratio sensor (sensor 2) current is -0.25757 mA or higher	• Air fuel ratio sensor (sensor 2) • Air fuel ratio sensor (sensor 1) • Gas leak from exhaust system • EGR valve assembly • Fuel system • Intake system	Comes on	Engine	B	SAE Code: P0136
P013A7C	A/F Sensor - Rich to Lean Bank 1 Sensor	During a fuel cut, the amount of time it takes for the current of the air fuel ratio	• Air fuel ratio sensor (sensor 2)	Comes on	Engine	B	SAE Code: P013A

DTC NO.	DETECTION ITEM	DTC DETECTION CONDITION	TROUBLE AREA	MIL	DTC OUTPUT FROM	PRIORITY	NOTE
	2 Slow Response	sensor (sensor 2) to increase to a certain amount is equal to or greater than the threshold (1 trip detection logic).	• Gas leak from exhaust system				

MONITOR DESCRIPTION

Active Air fuel Ratio Control

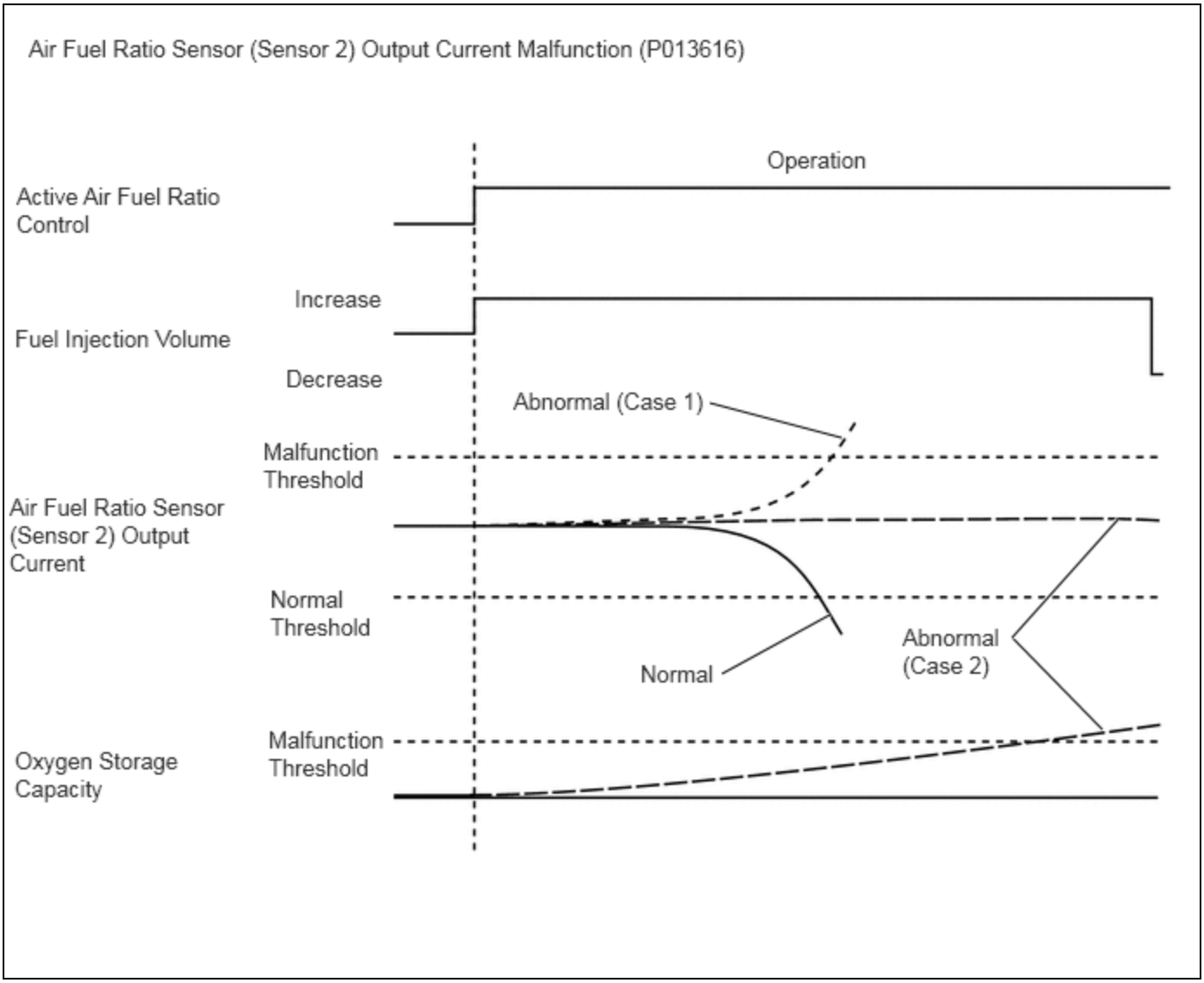
The ECM usually performs air fuel ratio feedback control so that the air fuel ratio sensors output indicates a near stoichiometric air fuel ratio. This vehicle includes active air fuel ratio control in addition to regular air fuel ratio control. The ECM performs active air fuel ratio control to detect any deterioration in the Three-Way Catalytic Converter (TWC) and any malfunctions of the air fuel ratio sensor (sensor 2) (refer to the diagram below).

Active air fuel ratio control is performed for approximately 30 seconds while driving with a warm engine. During active air fuel ratio control, the air fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, a DTC is stored.

Abnormal Air Fuel Ratio Sensor (Sensor 2) Output Current (DTC P013616)

Case 1: The ECM illuminates the MIL and stores a DTC when active rich air-fuel ratio control is being performed and the air fuel ratio sensor (sensor 2) current is 6 mA or more.

Case 2: The ECM illuminates the MIL and stores a DTC when active rich air-fuel ratio control is being performed, the oxygen storage capacity of the catalyst is more than 2 g and the air fuel ratio sensor (sensor 2) current is -0.25757 mA or more.



Abnormal Air Fuel Ratio Sensor (Sensor 2) Output Current During Fuel-cut from Rich Condition (DTC P013A7C)

During a fuel cut, if the amount of time it takes for the current of the air fuel ratio sensor (sensor 2) to increase to a certain amount is equal to or greater than the threshold, the responsiveness of the air fuel ratio sensor (sensor 2) is judged as degraded, the ECM illuminates the MIL and stores a DTC.

MONITOR STRATEGY

Related DTCs	P0136: Air fuel ratio sensor (sensor 2) output current malfunction P013A: Air fuel ratio sensor (sensor 2) response rate during fuel cut from rich condition
Required Sensors/Components (Main)	Air fuel ratio sensor (sensor 2)
Required Sensors/Components (Related)	Crankshaft position sensor Engine coolant temperature sensor Mass air flow meter sub-assembly Throttle position sensor Air fuel ratio sensor (sensor 1)

Frequency of Operation	Once per driving cycle
Duration	20 seconds: P0136 10 seconds: P013A
MIL Operation	2 driving cycles: P0136 Immediate: P013A
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All

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) 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) P014C, P014D, P015A, P015B, P2195, P2196, P2237, P2238, P2239, P2252, P2253 (Air fuel ratio sensor (sensor 1)) 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) P0400 (EGR system) 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)

P0136: Air Fuel Ratio Sensor (Sensor 2) Output Current Malfunction

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
Air fuel ratio sensor (sensor 1) status	Activated
Fuel system status	Closed loop
Engine load	10% or higher, and less than 80%

P013A: Air Fuel Ratio Sensor (Sensor 2) Response Rate During Fuel Cut from Rich Condition

Auxiliary battery voltage	11 V or higher
Engine coolant temperature	75°C (167°F) or higher
Catalyst temperature	520°C (968°F) or higher
Fuel cut	On
Air fuel ratio sensor (sensor 2) control circuit fail (P22AB, P22AC, P22AD, P22B3, P22B4)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

P0136: Air Fuel Ratio Sensor (Sensor 2) Output Current Malfunction

Both of the following conditions are met	A and B
A. Continuous time of active rich air fuel ratio control*1	0.5 seconds or more
*1: Target air fuel ratio	13.3 or less
B. Either of the following conditions is met	(a) or (b)
(a) Air fuel ratio sensor (sensor 2) current	6 mA or more
(b) OSC (Oxygen Storage Capacity) of catalyst	More than 2 g

P013A: Air Fuel Ratio Sensor (Sensor 2) Response Rate During Fuel Cut from Rich Condition

The amount of time it takes for the current of the air fuel ratio sensor (sensor 2) to increase to a certain amount during a fuel cut (Normalized)	More than 291 msec.

MONITOR RESULT

Refer to detailed information in Checking Monitor Status.

Click here INFO

P0136: O2 Sensor / CURRENT BELOW B1S2

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$02	$92	Multiply by 0.004	mA	Current below threshold for bank 1 sensor 2

P013A: O2 Sensor / SLOW RESPONSE B1S2

MONITOR ID	TEST ID	SCALING	UNIT	DESCRIPTION
$02	$93	Multiply by 1	ms	Slow response bank 1 sensor 2

CONFIRMATION DRIVING PATTERN

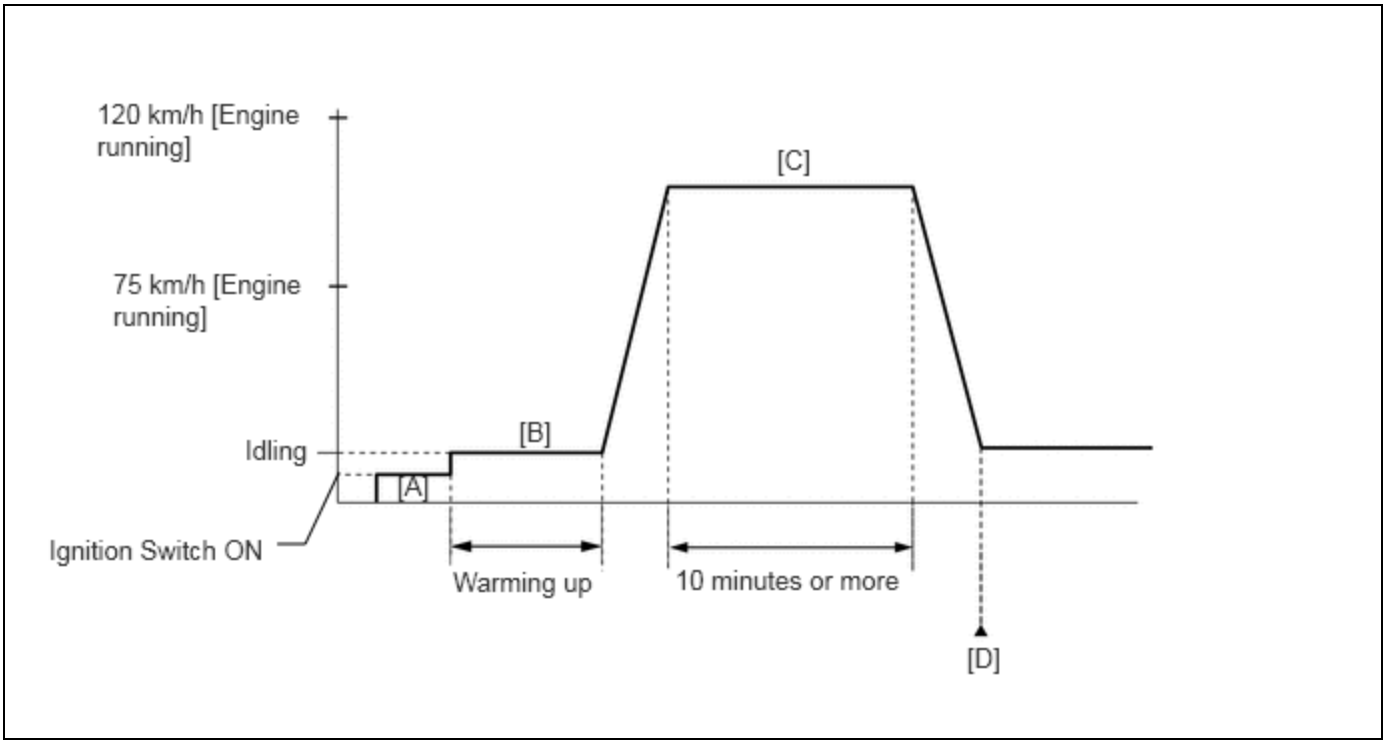
HINT:

- This confirmation driving pattern is used for the "Perform Confirmation Driving Pattern" procedure of the following diagnostic troubleshooting procedure.
- Performing this confirmation driving pattern will activate the air fuel ratio sensor (sensor 2) monitor (the catalyst monitor is performed simultaneously). 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

P013616



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. Turn the ignition switch to ON [A].
4. Put the engine in Inspection Mode (Maintenance Mode).

   Click here INFO

5. Start the engine and warm it up until the engine coolant temperature is 75°C (167°F) or higher with P selected [B].
6. Press the EV/HV mode selection switch to select HV mode. (for PHEV Model)
7. With the engine running, drive the vehicle at 75 to 120 km/h (46 to 75 mph) for 10 minutes or more [C].

CAUTION:

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

HINT:

If the engine stops, further depress the accelerator pedal to restart the engine.

8. Enter the following menus: Powertrain / Engine / Trouble Codes [D].
9. 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.

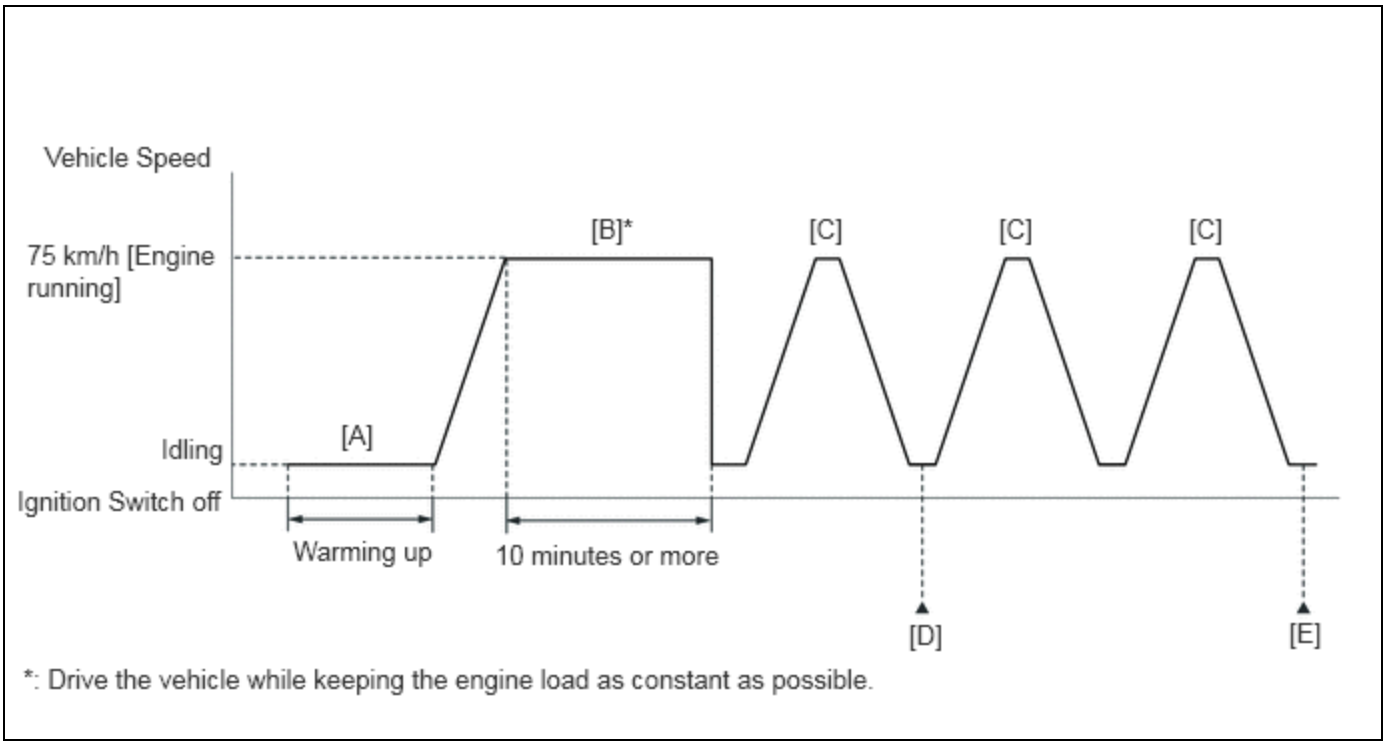
10. Enter the following menus: Powertrain / Engine / Utility / All Readiness.
11. Input the DTC: P013616.
12. Check the DTC judgment result.

HINT:

- If the judgment result is NORMAL, the system is normal.
- If the judgment result is ABNORMAL, the system is malfunctioning.
- If the judgment result is INCOMPLETE, perform steps [C] through [D] again.
- [B] to [D]: 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.

P013A7C



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

   Click here INFO
6. Start the engine and warm it up until the engine coolant temperature is 75°C (167°F) or higher with P selected [A].

   HINT:

   In order to keep the idle stable, turn off the A/C and all other electric loads and do not perform any shift operations.
7. Press the EV/HV mode selection switch to select HV mode. (for PHEV Model)
8. With the engine running, drive the vehicle at approximately 75 km/h (46 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.
   - If the engine stops, further depress the accelerator pedal to restart the engine.
9. With the shift lever in B, drive the vehicle at 75 km/h (46 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.

   HINT:

   If the engine stops, further depress the accelerator pedal to restart the engine.
10. Enter the following menus: Powertrain / Engine / Monitor / Current Monitor / O2 Sensor / Details / SLOW RESPONSE B1S2 [D].
11. Check the Test Value for SLOW RESPONSE B1S2.

    HINT:

    If Test Value displays 0, perform step [C] until in displays a value larger than 0, as the O2 Sensor monitor is not finished.
12. Repeat step [C] 2 times or more in one driving cycle.
13. Enter the following menus: Powertrain / Engine / Trouble Codes / Pending [E].
14. 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.
15. Enter the following menus: Powertrain / Engine / Utility / All Readiness.
16. Input the DTC: P013A7C.
17. Check the DTC judgment result.

    HINT:

    - If the judgment result is NORMAL, the system is normal.
    - If the judgment result is ABNORMAL, the system is malfunctioning.
    - If the judgment result is INCOMPLETE, drive the vehicle with the shift lever in B, and then perform step [C] again.
    - [A] to [E]: 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.

WIRING DIAGRAM

Refer to DTC P003612.

Click here INFO

CAUTION / NOTICE / HINT

HINT:

Malfunctioning areas can be identified by performing the Active Test "Control the Injection Volume for A/F Sensor". This Active Test can help to determine whether the air fuel ratio sensors (sensor 1 and sensor 2) and other potential trouble areas are malfunctioning.

The following procedure describes how to perform the Active Test "Control the Injection Volume for A/F Sensor" using the GTS.

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

   Click here INFO
2. Start the engine and warm it up until the engine coolant temperature is 75°C (167°F) or higher.
3. Idle the engine for 5 minutes or more with P selected.
4. Enter the following menus: Powertrain / Engine / Active Test / Control the Injection Volume for A/F Sensor / Data List / A/F (O2) Sensor Current B1S1 and A/F (O2) Sensor Current B1S2.
5. Perform the Active Test with the engine idling (change the fuel injection volume).
6. 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.

HINT:

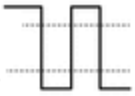
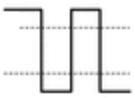
- The Active Test "Control the Injection Volume for A/F Sensor" can be used to lower the fuel injection volume by 12.5% or increase the injection volume by 12.5%.
- Each sensor reacts in accordance with the increase and decrease in the fuel injection volume.

Standard

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

NOTICE:

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.

Case	Air Fuel Ratio Sensor (Sensor 1) Output Current	Air Fuel Ratio Sensor (Sensor 2) Output Current	Main Suspected Trouble Area
1	Injection Volume 12.5% -12.5%  Output Current More than 0.037 mA Below -0.075 mA  OK	Injection Volume 12.5% -12.5%  Output Current More than 0.33 mA Below -0.86 mA  OK	-
2	Injection Volume 12.5% -12.5%  Output Current Almost no reaction NG	Injection Volume 12.5% -12.5%  Output Current More than 0.33 mA Below -0.86 mA  OK	- Air fuel ratio sensor (sensor 1) - Air fuel ratio sensor (sensor 1) heater - Air fuel ratio sensor (sensor 1) circuit
3	Injection Volume 12.5% -12.5%  Output Current More than 0.037 mA Below -0.075 mA  OK	Injection Volume 12.5% -12.5%  Output Current Almost no reaction NG	- Air fuel ratio sensor (sensor 2) - Air fuel ratio sensor (sensor 2) heater - Air fuel ratio sensor (sensor 2) circuit
4	Injection Volume 12.5% -12.5%  Output Current Almost no reaction NG	Injection Volume 12.5% -12.5%  Output Current Almost no reaction NG	- Fuel system - Gas leak from exhaust system

Performing the Active Test "Control the Injection Volume for A/F Sensor" allows the output value of the air fuel ratio sensors (sensor 1 and sensor 2) to be checked and graphed.

NOTICE:

- Inspect the fuses for circuits related to this system before performing the following procedure.
- 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:

- 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.	**READ OUTPUT DTC (IN ADDITION TO DTC P013616 AND P013A7C)**

(a) Read the DTCs.

Powertrain > Engine > Trouble Codes

RESULT	PROCEED TO
P013616 or P013A7C and other DTCs are output	A
P013616 is output	B
P013A7C is output	C

HINT:

If any DTCs other than P013616 or P013A7C are output, troubleshoot those DTCs first.

A ▶ GO TO DTC CHART

C ▶ GO TO STEP 43

B

2.	**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 reaches 75°C (167°F) or higher.

Powertrain > Engine > Data List

TESTER DISPLAY
Coolant Temperature

Procedure1

(c) Idle the engine for 5 minutes or more with P selected.

(d) Perform the Control the Injection Volume for A/F Sensor operation with the engine idling.

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

(e) Monitor the output values of the air fuel ratio sensor (sensor 1) and air fuel ratio sensor (sensor 2) (A/F (O2) Sensor Current B1S1 and A/F (O2) Sensor Current B1S2) displayed on the GTS.

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 12.5%.

- 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 value 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 OF A/F (O2) SENSOR CURRENT B1S1	STATUS OF A/F (O2) SENSOR CURRENT B1S2	SUSPECTED TROUBLE AREA	PROCEED TO
Lean/Rich	Lean/Rich	• Air fuel ratio sensor (sensor 2)	A
Lean	Lean	• Gas leak from exhaust system • EGR valve assembly • Extremely lean actual air fuel ratio • Air fuel ratio sensor (sensor 2)	B
Rich	Rich	• Gas leak from exhaust system • EGR valve assembly • Extremely rich actual air fuel ratio • Air fuel ratio sensor (sensor 2)	
Lean/Rich	Lean	• Air fuel ratio sensor (sensor 2) • Gas leak from exhaust system	C
Lean/Rich	Rich	• Air fuel ratio sensor (sensor 2) • Gas leak from exhaust system	
Lean	Lean/Rich	• Air fuel ratio sensor (sensor 1) • Air fuel ratio sensor (sensor 2)	D

STATUS OF A/F (O2) SENSOR CURRENT B1S1	STATUS OF A/F (O2) SENSOR CURRENT B1S2	SUSPECTED TROUBLE AREA	PROCEED TO
Rich	Lean/Rich	• Air fuel ratio sensor (sensor 1) • Air fuel ratio sensor (sensor 2)	

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) alternate 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

(f) None

B ▶ **GO TO STEP 6**

C ▶ **GO TO STEP 13**

D ▶ **GO TO STEP 41**

A

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

HINT:

Click here INFO

NEXT

4.	**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

5.	**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 the DTC judgment result.

Powertrain > Engine > Utility

TESTER DISPLAY
All Readiness

(c) Input the DTC: P013616.

Result

GTS DISPLAY	DESCRIPTION
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions

Post-procedure1

(d) None

NEXT ▶ **END**

6.	**CHECK FOR EXHAUST GAS LEAK**

(a) Check for exhaust gas leaks.

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 ▼

7.	**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 9**

B

8.	**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

9.	**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 14**

C ▶ **GO TO STEP 27**

D ▶ **GO TO STEP 30**

A

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

Click here INFO

RESULT	PROCEED TO
YES	A
NO	B

B ▶ **GO TO STEP 12**

A

11.	**DTC CAUSED BY RUNNING OUT OF FUEL**

(a) DTC caused by running out of fuel.

NEXT ▶ **GO TO STEP 81**

12.	**CHECK FOR INTERMITTENT PROBLEMS**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

13.	**CHECK FOR EXHAUST GAS LEAK**

(a) Check for exhaust gas leaks.

OK:

No gas leaks in exhaust system.

HINT:

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

Click here INFO

OK ▶ **REPLACE AIR FUEL RATIO SENSOR (SENSOR 2)**

NG ▶ **REPAIR OR REPLACE EXHAUST SYSTEM**

14.	**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 21**

A

▼

15.	**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 19**

C ▶ **GO TO STEP 22**

D ▶ **GO TO STEP 20**

A

16.	**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 18**

A

17.	**REPLACE DIRECT FUEL INJECTOR ASSEMBLY**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

18.	**CHECK FOR INTERMITTENT PROBLEMS**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

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

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

20.	**REPLACE ECM**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

21.	**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 25**

A

▼

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

Click here INFO

NEXT

▼

23.	**CLEAR DTC**

Click here INFO

NEXT

24.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P013616)**

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: P013616.

RESULT	PROCEED TO
NORMAL (DTCs are not output)	A
ABNORMAL (DTC P013616 is output)	B

Post-procedure1

(d) None

A ▶ **GO TO STEP 81**

B ▶ **GO TO STEP 26**

25.	**REPLACE DIRECT FUEL INJECTOR ASSEMBLY**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

26.	**REPLACE ECM**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

27.	**INSPECT PORT FUEL INJECTOR ASSEMBLY**

Click here INFO

NG ▶ **GO TO STEP 29**

OK

▼

28.	**REPLACE ECM**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

29.	**REPLACE PORT FUEL INJECTOR ASSEMBLY**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

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

Click here INFO

NG ▶ **GO TO STEP 80**

OK

▼

31.	**CHECK INTAKE SYSTEM**

Click here INFO

NG ▶ **GO TO STEP 79**

OK ▼

32.	**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 • 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	

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
			• 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 52**

A

▼

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

Click here INFO

NG ▶ **GO TO STEP 51**

OK

▼

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

Click here INFO

OK ▶ **GO TO STEP 36**

NG

▼

35.	**INSPECT EGR VALVE ASSEMBLY**

Click here INFO

NG ▶ **GO TO STEP 50**

OK ▼

36.	**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 60**

A ▼

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

Click here INFO

NG ▶ **GO TO STEP 47**

OK ▼

38.	**CHECK FOR EXHAUST GAS LEAK**

Click here INFO

NG ▶ **GO TO STEP 46**

OK ▼

39.	**INSPECT SPARK PLUG**

Click here INFO

NG ▶ **GO TO STEP 42**

OK
▼

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

Click here INFO

NEXT ▶ **GO TO STEP 60**

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

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

42.	**REPLACE SPARK PLUG**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

43.	**CHECK FOR EXHAUST GAS LEAK**

(a) Check for exhaust gas leaks.

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

44.	**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

45.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P013A7C)**

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: P013A7C.

RESULT	PROCEED TO
NORMAL (DTCs are not output)	A
ABNORMAL (DTC P013A7C is output)	B

Post-procedure1

(d) None

A ▶ **CHECK FOR INTERMITTENT PROBLEMS**

B ▶ **REPLACE AIR FUEL RATIO SENSOR (SENSOR 2)**

46.	**REPAIR OR REPLACE EXHAUST SYSTEM**

(a) Repair or replace exhaust system.

NEXT ▶ **GO TO STEP 81**

47.	**CHECK FUEL LINE**

Click here INFO

NG ▶ **GO TO STEP 49**

OK ▼

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

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

49.	**REPAIR OR REPLACE FUEL SYSTEM**

(a) Repair or replace fuel system.

NEXT ▶ **GO TO STEP 81**

50.	**REPLACE EGR VALVE ASSEMBLY**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

51.	**REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

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

Click here INFO

NG ▶ **GO TO STEP 78**

OK ▼

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

Click here INFO

NG ▶ **GO TO STEP 63**

OK ▼

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

Click here INFO

NG ▶ **GO TO STEP 58**

OK ▼

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

Click here INFO

NEXT

56.	**CLEAR DTC**

Click here INFO

NEXT

57.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P013616)**

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: P013616.

RESULT	PROCEED TO
NORMAL (DTCs are not output)	A
ABNORMAL (DTC P013616 is output)	B

Post-procedure1

(d) None

A ▶ GO TO STEP 81

B ▶ GO TO STEP 59

58.	**REPAIR OR REPLACE HARNESS OR CONNECTOR**

(a) Repair or replace harness or connector.

NEXT **GO TO STEP 81**

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

Click here INFO

NEXT

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

Click here INFO

NEXT

61.	**CLEAR DTC**

Click here INFO

NEXT

62.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P013616)**

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: P013616.

RESULT	PROCEED TO
NORMAL (DTCs are not output)	A
ABNORMAL (DTC P013616 is output)	B

Post-procedure1

(d) None

A ▶ **GO TO STEP 81**

B ▶ **GO TO STEP 68**

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

Click here INFO

NG ▶ **GO TO STEP 77**

OK ▼

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

Click here INFO

NG ▶ **GO TO STEP 76**

OK ▼

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

Click here INFO

NG ▶ **GO TO STEP 75**

OK
▼

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

Click here INFO

NG ▶ **GO TO STEP 72**

OK
▼

67.	**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**

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

Click here INFO

NG ▶ **GO TO STEP 73**

OK
▼

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

Click here INFO

NEXT

70.	**CLEAR DTC**

Click here INFO

NEXT

71.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P013616)**

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: P013616.

RESULT	PROCEED TO
NORMAL (DTCs are not output)	A
ABNORMAL (DTC P013616 is output)	B

Post-procedure1

(d) None

A ▶ **GO TO STEP 81**

B ▶ **GO TO STEP 74**

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

(a) Repair or replace harness or connector.

NEXT ▶ **GO TO STEP 81**

73.	**REPAIR OR REPLACE HARNESS OR CONNECTOR**

(a) Repair or replace harness or connector.

NEXT ▶ **GO TO STEP 81**

74.	**REPLACE ECM**

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

75.	**REPAIR OR REPLACE HARNESS OR CONNECTOR**

(a) Repair or replace harness or connector.

NEXT ▶ **GO TO STEP 81**

76.	**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**

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

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

NEXT ▶ **GO TO STEP 81**

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

HINT:

Click here INFO

NEXT ▶ **GO TO STEP 81**

79.	**REPAIR OR REPLACE INTAKE SYSTEM**

(a) Repair or replace intake system.

NEXT ▶ **GO TO STEP 81**

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

(a) Repair or replace PCV valve or hose.

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.	**CHECK WHETHER DTC OUTPUT RECURS (DTC P013616)**

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: P013616.

RESULT	PROCEED TO
NORMAL (DTCs are not output)	A
ABNORMAL (DTC P013616 is output)	B

Post-procedure1

(d) None

A ▶ **END**

B ▶ **REPLACE AIR FUEL RATIO SENSOR (SENSOR 2)**