

Repair Manual • 2ZR-FXE Engine Control • SFI System • P0171, P0172

P0171System Too Lean (Bank 1)P0172System Too Rich (Bank 1)

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection duration. The fuel trim consists of both the short-term and long-term fuel trim.

The short-term fuel trim is fuel compensation that is used to constantly maintain the air fuel ratio at stoichiometric levels. The signal from the air fuel ratio sensor indicates whether the air fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air fuel ratio is rich and an increase in the fuel injection volume if it is lean.

Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.

DTC No.	DTC Detection Condition	Trouble Area
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DTC No.	DTC Detection Condition	Trouble Area
P0171	<p>With warm engine and stable air fuel ratio feedback, fuel trim considerably in error to lean side</p> <p>(2 trip detection logic)</p>	<ul style="list-style-type: none"> • Intake system • Fuel injector assembly • Mass air flow meter sub-assembly • Engine coolant temperature sensor • Fuel pressure • Gas leaks from exhaust system • Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • PCV valve and hose • PCV hose connections • EGR valve assembly • Wire harness or connector • ECM
P0172	<p>With warm engine and stable air fuel ratio feedback, fuel trim considerably in error to rich side</p> <p>(2 trip detection logic)</p>	<ul style="list-style-type: none"> • Fuel injector assembly • Mass air flow meter sub-assembly • Engine coolant temperature sensor • Ignition system • Fuel pressure • Gas leak from exhaust system • Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • EGR valve assembly • Wire harness or connector • ECM

Hint:

- When DTC P0171 is stored, the actual air fuel ratio is on the lean side. When DTC P0172 is stored, the actual air fuel ratio is on the rich side.
- If the vehicle runs out of fuel, the air fuel ratio is lean and DTC P0171 may be stored. The MIL then illuminates.

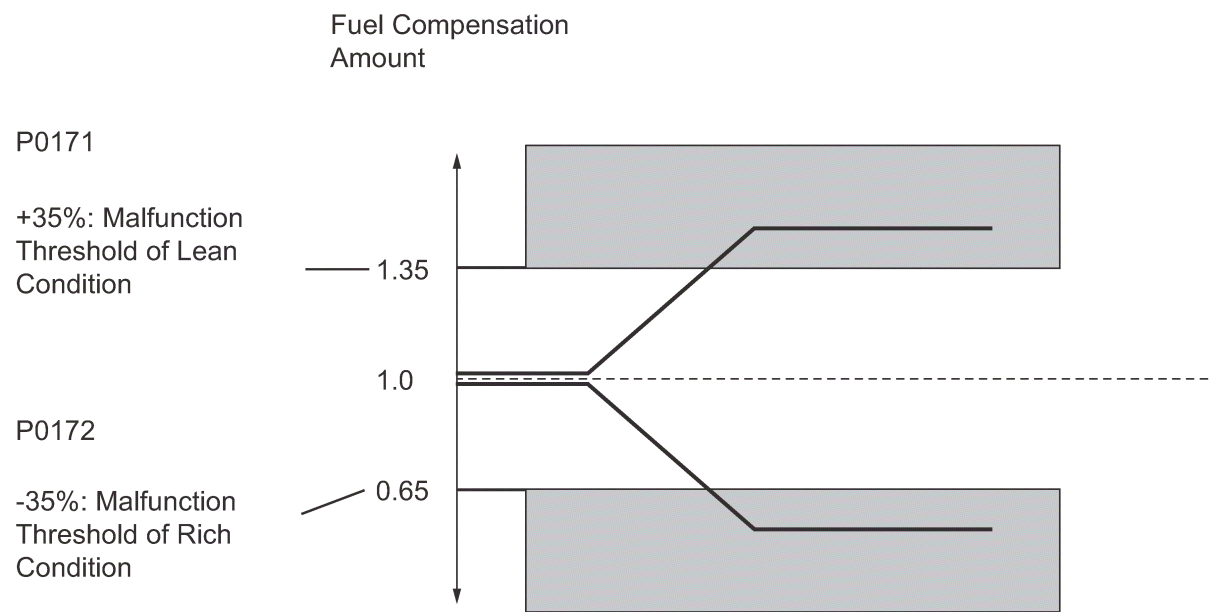
- When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is more than 75°C (167°F)), the system is functioning normally.

MONITOR DESCRIPTION

Under closed-loop fuel control, a fuel injection volume that deviates from that estimated by the ECM causes changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim value. Deviations from the ECM's estimated fuel injection volume also affect the average fuel trim learning value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learning value of the air fuel ratio). If the average fuel trim learning value exceeds a malfunction threshold, the ECM interprets this a fault in the fuel system and stores a DTC.

Example:

The average fuel trim learning value is 35% or more, or -35% or less, the ECM interprets this as a fuel system malfunction.



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MONITOR STRATEGY

Related DTCs	P0171: Fuel trim Lean (bank 1)
	P0172: Fuel trim Rich (bank 1)
Required Sensors/Components (Main)	Fuel system

Required Sensors/Components (Related)	Air fuel ratio sensor
	Mass air flow meter sub-assembly
	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	Within 10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

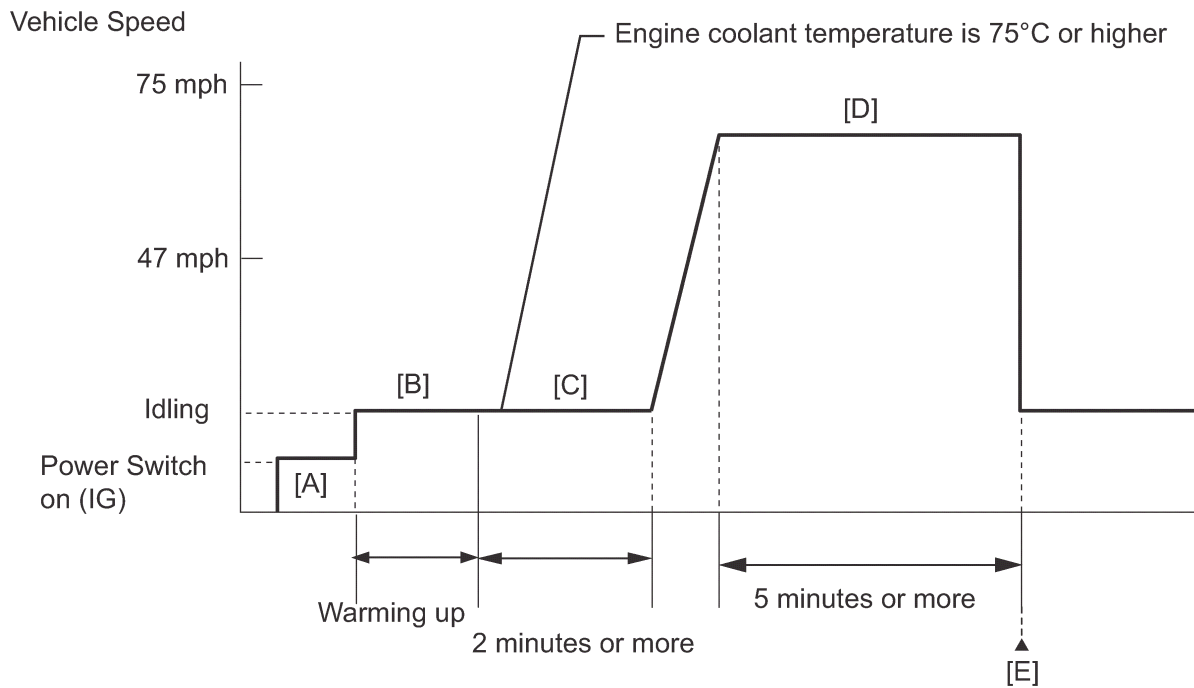
Monitor runs whenever following DTCs are not present	<p>P0010 (Camshaft timing oil control valve assembly bank 1)</p> <p>P0011 (VVT system bank 1- advance)</p> <p>P0012 (VVT system bank 1- retard)</p> <p>P0016 (VVT system bank 1 - misalignment)</p> <p>P0031, P0032, P101D (Air fuel ratio sensor heater - sensor 1)</p> <p>P0102, P0103 (Mass air flow meter)</p> <p>P0107, P0108 (Manifold absolute pressure)</p> <p>P0115, P0117, P0118 (Engine coolant temperature sensor)</p> <p>P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle position sensor)</p> <p>P0125 (Insufficient coolant temperature for closed loop fuel control)</p> <p>P0335 (Crankshaft position sensor)</p> <p>P0340, P0342, P0343 (Camshaft position sensor)</p> <p>P0351, P0352, P0353, P0354 (Igniter)</p> <p>P0401 (EGR system (closed))</p> <p>P219A (Air fuel ratio sensor - imbalance)</p>
Fuel system status	Closed-loop
Auxiliary battery voltage	11 V or more

Either of the following conditions 1 or 2 is set	-
1. Engine speed	Less than 1100 rpm
2. Intake air amount per revolution	0.12 g/rev or more
Catalyst monitor	Not executed

TYPICAL MALFUNCTION THRESHOLDS

Purge-cut	Executing
Either of the following conditions 1 or 2 is met	-
1. Average between short-term fuel trim and long-term fuel trim	35% or more (varies with engine coolant temperature)
2. Average between short-term fuel trim and long-term fuel trim	-35% or less (varies with engine coolant temperature)

CONFIRMATION DRIVING PATTERN



1. Connect the Techstream to the DLC3.
2. Turn the power switch on (IG) and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the power switch off and wait for 30 seconds.
5. Turn the power switch on (IG) and turn the Techstream on [A].
6. Put the engine in inspection mode (maintenance mode) [More Info](#).
7. Start the engine and warm it up (until the engine coolant temperature is 75°C (167°F) or higher) with all the accessories switched off [B].
8. With the engine warmed up, idle the engine for 2 minutes or more [C].

9. Drive the vehicle at between 47 and 75 mph (75 and 120 km/h) for 5 minutes or more [D].

CAUTION:

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

10. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.

11. Read the pending DTC [E].

Hint:

- If a pending DTC is output, the system is malfunctioning.

12. If no pending DTC is output, perform a universal trip and check for permanent DTCs [More Info](#).

Hint:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to DTC P0102 [More Info](#).

Refer to DTC P2195 [More Info](#).

INSPECTION PROCEDURE

NOTICE:

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

Hint:

- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can 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.
- A low air fuel ratio sensor voltage could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A high air fuel ratio sensor voltage could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.
- 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 P0171 OR P0172)

- a. Connect the Techstream to the DLC3.
- b. Turn the power switch on (IG).
- c. Turn the Techstream on.
- d. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes.

e. Read the DTCs.

Result

Result	Proceed to
DTC P0171 or P0172 is output	A
DTC P0171 or P0172 and other DTCs are output	B

Hint:

If any DTCs other than P0171 or P0172 are output, troubleshoot those DTCs first.

B ► [More Info](#)

A
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2. CHECK PCV HOSE CONNECTIONS

- a. Inspect the PCV hose connections. [More Info](#)

OK

PCV hose is connected correctly and is not damaged.

NG ► REPAIR OR REPLACE PCV HOSE

OK
▼

3. CHECK INTAKE SYSTEM

- a. Check the intake system for vacuum leaks [More Info](#).

OK

No leaks in intake system.

NG ► REPAIR OR REPLACE INTAKE SYSTEM

OK
▼

4. PERFORM ACTIVE TEST USING TECHSTREAM (CONTROL THE INJECTION VOLUME)

- a. Connect the Techstream to the DLC3.
- b. Turn the power switch on (IG).
- c. Turn the Techstream on.
- d. Put the engine in inspection mode (maintenance mode) [More Info](#)
- e. Start the engine.
- f. Warm up the engine and run the engine at an engine speed of 2500 rpm for approximately 90 seconds.

Hint:

During charging control, the engine speed is set at idle. Therefore, the engine speed does not increase when depressing the accelerator pedal. In this case, warm up the engine after charging control has completed.

- g. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the Injection Volume / Gas AF Control / AFS Voltage B1S1 and O2S B1S2.
- h. Perform the Control the Injection Volume operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
- i. Monitor the voltage outputs of the air fuel ratio sensor and the heated oxygen sensor (AFS Voltage B1S1 and O2S B1S2) displayed on the Techstream.

Hint:

- Change the fuel injection volume within the range of -12% to +12%. 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.
- If the sensor output voltage does not change (almost no reaction) while performing the Active Test, the sensor may be malfunctioning.

Standard

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

Result

Status	Status	Air Fuel Ratio Condition and	Suspected Trouble Area	Proceed to
AFS Voltage B1S1	O2S B1S2	Air Fuel Ratio Sensor Condition		
Lean/Rich	Lean/Rich	Normal	-	A

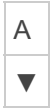
Status	Status	Air Fuel Ratio Condition and	Suspected Trouble Area	Proceed to
AFS Voltage B1S1	O2S B1S2	Air Fuel Ratio Sensor Condition		
Lean	Lean	Actual air fuel ratio lean	<ul style="list-style-type: none"> ■ PCV valve and hose ■ PCV hose connections ■ Fuel injector assembly blockage ■ Gas leak from exhaust system ■ Intake system ■ Fuel pressure ■ Mass air flow meter sub-assembly ■ Engine coolant temperature sensor ■ EGR valve assembly 	A
Rich	Rich	Actual air fuel ratio rich	<ul style="list-style-type: none"> ■ Fuel injector assembly leak or blockage ■ Gas leak from exhaust system ■ Ignition system ■ Fuel pressure ■ Mass air flow meter sub-assembly ■ Engine coolant temperature sensor 	A
Lean	Lean/Rich	Air fuel ratio sensor malfunction	<ul style="list-style-type: none"> ■ Air fuel ratio sensor ■ EGR valve assembly 	B
Rich	Lean/Rich	Air fuel ratio sensor malfunction	<ul style="list-style-type: none"> ■ Air fuel ratio sensor 	B

- Lean: During Control the Injection Volume, the air fuel ratio sensor output voltage (AFS Voltage B1S1) is consistently higher than 3.4 V, and the heated oxygen sensor output voltage (O2S B1S2) is consistently below 0.4 V.
- Rich: During Control the Injection Volume, the AFS Voltage B1S1 is consistently below 3.1 V, and the O2S B1S2 is consistently higher than 0.55 V.

- Lean/Rich: During Control the Injection Volume of the Active Test, the output voltage of the heated oxygen sensor alternates correctly.

Hint:

Refer to "Data List / Active Test" [AFS Voltage B1S1 and O2S B1S2] [More Info](#).

**5. READ VALUE USING TECHSTREAM (COOLANT TEMP)**

- Connect the Techstream to the DLC3.
- Turn the power switch on (IG).
- Turn the Techstream on.
- Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / Coolant Temp.
- Read the Data List twice, when the engine is both cold and warmed up.

Standard value

With cold engine: Same as ambient air temperature.

With warm engine: Between 75°C to 100°C (167°F to 212°F).

**6. READ VALUE USING TECHSTREAM (MAF)**

- Connect the Techstream to the DLC3.
- Turn the power switch on (IG).
- Turn the Techstream on.
- Put the engine in inspection mode (maintenance mode) [More Info](#).
- Start the engine.
- Enter the following menus: Powertrain / Engine and ECT / Data List / Primary / MAF and Coolant Temp.
- Allow the engine to idle until Coolant Temp reaches 75°C (167°F) or higher.
- Read MAF with the engine speed at 2500 rpm.

Standard

Between 4.5 gm/sec and 8.5 gm/sec (shift position: P).

Hint:

During charging control, the engine speed is set at idle. Therefore, the engine speed does not increase when depressing the accelerator pedal. In this case, read the Data List after charging control has completed.

NG	▶	GO TO STEP 18
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OK
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7. CHECK FUEL PRESSURE

- a. Check the fuel pressure [More Info](#).

NG	▶	REPAIR OR REPLACE FUEL SYSTEM
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OK
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8. CHECK FOR EXHAUST GAS LEAK

- a. Check for exhaust gas leaks.

OK

No gas leaks

NG	▶	REPAIR OR REPLACE EXHAUST SYSTEM
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OK
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9. CHECK FOR SPARK (SPARK TEST)

- a. Perform a spark test [More Info](#).

Hint:

- If the result of the spark test is normal, proceed to the next step.
- If the spark plugs or ignition system malfunctions, engine misfire may occur. The misfire count can be read using the Techstream. Enter the following menus: Powertrain / Engine and ECT / Data List / Gas Misfire / Cylinder #1 Misfire Count (to Cylinder #4 Misfire Count).

NEXT
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10. INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)

- a. Check the injection and volume [More Info](#)

OK	▶	GO TO STEP 15
NG	▶	More Info

11. INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE) [More Info](#)

NG	▶	More Info
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OK
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12. CHECK TERMINAL VOLTAGE (POWER SOURCE OF AIR FUEL RATIO SENSOR) [More Info](#)

NG	▶	REPAIR OR REPLACE HARNESS OR CONNECTOR (AIR FUEL RATIO SENSOR - EFI MAIN RELAY)
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OK
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13. CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM) [More Info](#)

NG	▶	REPAIR OR REPLACE HARNESS OR CONNECTOR
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OK
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14. REPLACE AIR FUEL RATIO SENSOR

- a. Replace the air fuel ratio sensor [More Info](#).

NEXT
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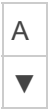
15. CHECK WHETHER DTC OUTPUT RECURS (DTC P0171 OR P0172)

- a. Connect the Techstream to the DLC3.
- b. Turn the power switch on (IG).
- c. Turn the Techstream on.
- d. Clear the DTCs [More Info](#).
- e. Turn the power switch off and wait for at least 30 seconds.
- f. Turn the power switch on (IG) and turn the Techstream on.
- g. Put the engine in inspection mode (maintenance mode) [More Info](#).
- h. Start the power and warm it up.
- i. Drive the vehicle in accordance with the driving pattern described in the Confirmation Driving Pattern.
- j. Enter the following menus: Powertrain / Engine and ECT / Utility / Trouble Codes / Pending.
- k. Read the pending DTCs.

Result

Result	Proceed to
DTC P0171 or P0172 is output	A
DTC is not output	B

B	▶	END
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16. PERFORM ACTIVE TEST USING TECHSTREAM (CONTROL THE EGR STEP POSITION)

- a. Connect the Techstream to the DLC3.
- b. Turn the power switch on (IG).
- c. Turn the Techstream on.
- d. Put the engine in inspection mode (maintenance mode) [More Info](#).
- e. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or more.

Hint:

The A/C switch and all accessory switches should be off.

- f. Enter the following menus: Powertrain / Engine and ECT / Active Test / Control the EGR Step Position / Data List / All Data / Throttle Idle Position and MAP.
- g. Confirm that the Throttle Idle Position is ON and check the MAP value in the Data List while performing the Active Test.

NOTICE:

- 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

MAP change in response to EGR step position when Throttle Idle Position is ON in Data List.

Standard

-	EGR Step Position (Active Test)	
	0 Steps	0 to 30 Steps
MAP (Data List)	(EGR valve is fully closed)	MAP value is at least +10 kPa (75 mmHg) higher than when EGR valve is fully closed

Hint:

- While performing the Active Test, if the increase in the value of MAP is small, the EGR valve assembly may be a malfunctioning.
- Even if the EGR valve assembly is malfunctioning, rough idling or an increase in the value of MAP may occur while performing the Active Test. However, the amount that the value of MAP increases will be smaller than normal.

NG▶

[GO TO STEP 17](#)

17. INSPECT EGR VALVE ASSEMBLY

- a. Remove the EGR valve assembly [More Info](#).
- b. Check if the EGR valve is stuck open.

OK

EGR valve is tightly closed.

NG▶

[More Info](#)

OK

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

- a. Check the connection and terminal contact pressure of connectors and wire harnesses between the mass air flow meter sub-assembly and ECM [More Info](#).

Hint:

Repair any problems.

NEXT

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19. CHECK WHETHER DTC OUTPUT RECURS (DTC P0171 OR P0172)

- a. Connect the Techstream to the DLC3.
- b. Turn the power switch on (IG).
- c. Turn the Techstream on.
- d. Clear the DTCs [More Info](#).
- e. Turn the power switch off and wait for at least 30 seconds.
- f. Turn the power switch on (IG) and turn the Techstream on.
- g. Put the engine in inspection mode (maintenance mode) [More Info](#).
- h. Start the engine and warm it up.
- i. Drive the vehicle in accordance with the driving pattern described in Confirmation Driving Pattern.
- j. Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.
- k. Read the pending DTCs.

Result

Result	Proceed to
DTC P0171 or P0172 is output	A

Result	Proceed to
DTC is not output	B

B ► END

A
▼

20. CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER SUB-ASSEMBLY - ECM) [More Info](#)

NG ► REPAIR OR REPLACE HARNESS OR CONNECTOR

OK
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21. REPLACE MASS AIR FLOW METER SUB-ASSEMBLY

- Replace the mass air flow meter sub-assembly [More Info](#).

Hint:

If the result of the inspection performed in step 6 indicated no problem, proceed to the next step without replacing the mass air flow meter sub-assembly.

NEXT
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22. CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED

- Connect the Techstream to the DLC3.
- Turn the power switch on (IG).
- Turn the Techstream on.
- Clear the DTC [More Info](#).
- Turn the power switch off and wait for at least 30 seconds.
- Turn the power switch on (IG) and turn the Techstream on.
- Put the engine in inspection mode (maintenance mode) [More Info](#).
- Start the engine and warm it up.
- Drive the vehicle in accordance with the driving pattern described in the Confirmation Driving Pattern.
- Enter the following menus: Powertrain / Engine and ECT / Trouble Codes / Pending.
- Read the pending DTCs.

Result

Result	Proceed to
DTC is not output	A

Result	Proceed to
DTC P0171 or P0172 is output	B

B	▶	More Info
A	▶	END

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