02- Engine

Emission control system

Technical specifications

Torque Specifications

Name	Torque range	
	Metric(Nm)	British(lb-ft)
Front oxygen sensor	40	30
Rear oxygen sensor	40	30

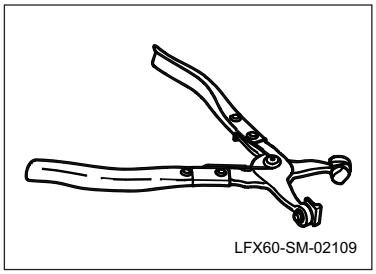
Precautions

Precautions

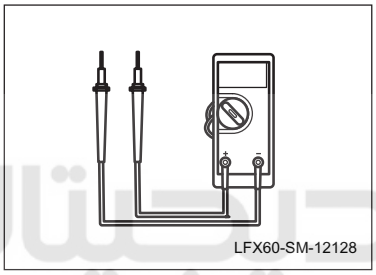
1. Be careful not to get burnt when the engine is very hot.
2. Do not remove the oxygen sensor when the engine is very hot, as this can damage the screw socket.

Preparation

Special maintenance tools

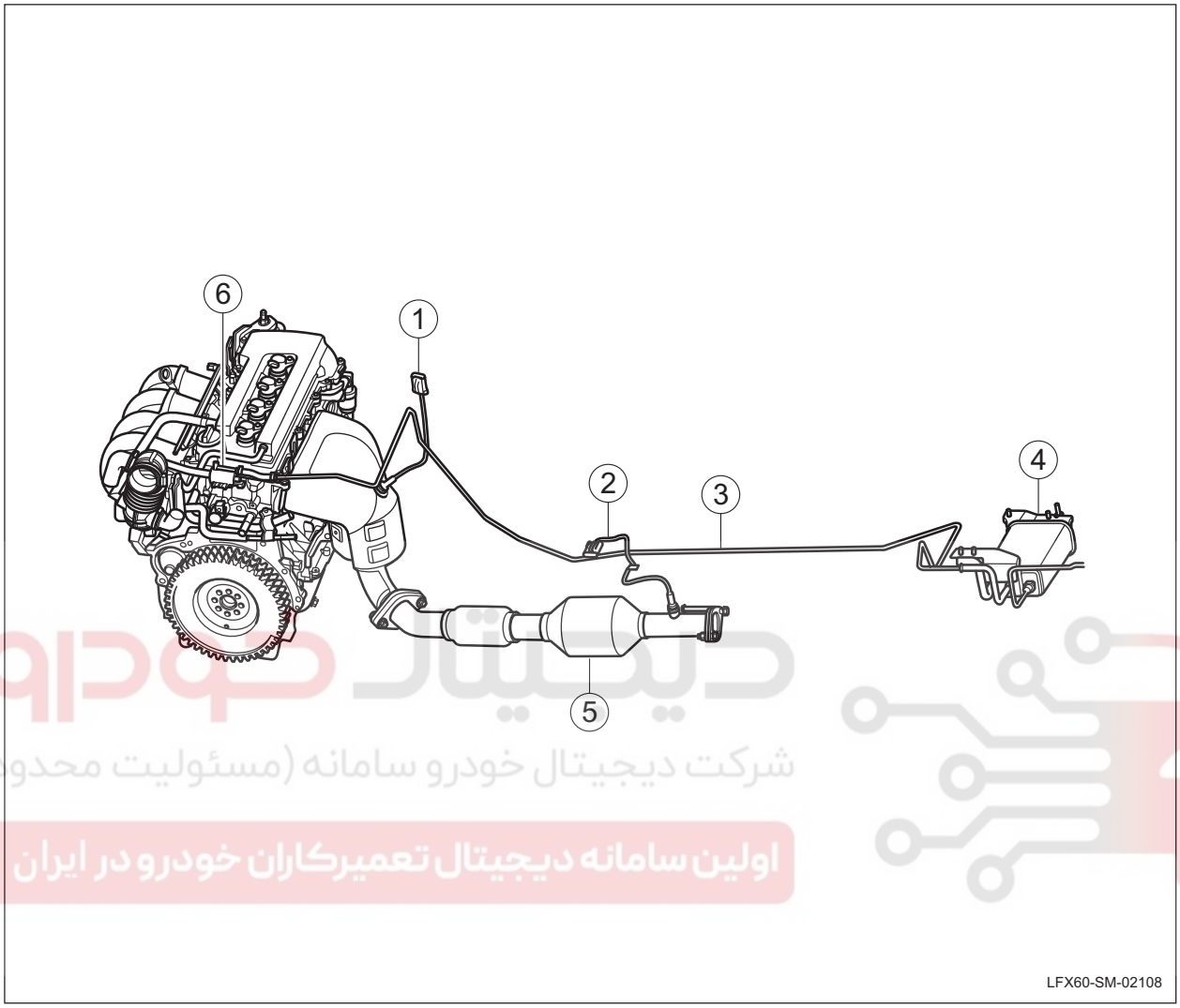
No.	Tool name	Tool figure	Tool code	Remarks
1	Pipe wrench	 LFX60-SM-02109	-	Remove the water pipe clamps

General maintenance tools

No.	Tool name	Tool figure	Tool code	Remarks
1	Digital universal meter	 LFX60-SM-12128	-	Measure the voltage and resistance

Structure and installation location

Component Location Plan



No.	Part Name
1	Front oxygen sensor
2	Rear oxygen sensor
3	Desorption tube II

No.	Part Name
4	Canister Assembly
5	Rear catalyst assembly
6	Canister solenoid valve

General Inspection

General Inspection

Inspection of the positive crankcase ventilation valve

If the engine is idling unstably, check if the positive crankcase ventilation valve is blocked, and if the vent hole filter and air filter element are too dirty or blocked. Execute the following procedures:

1. Remove the positive crankcase ventilation valve from the valve chamber cover.
2. Start the engine and run it idling.
3. Put your finger at the valve end, check the vacuum. If the valve is not vacuum, check the following items: hose is blocked.
4. Manifold port is blocked.
5. Crankcase ventilation valve is blocked.

The positive crankcase ventilation valve or hose blockage may lead to the following problems:

- Engine idling instable.
- Engine stall or idling slowly.
- Engine oil leakage.
- Oil enters the air filter.
- Oil dirt in the engine.
- Engine crankcase pressure is too high.

The positive crankcase ventilation valve or hose leakage may lead to the following problems:

- Engine idling instable.
- Engine stall.
- engine is idling too fast.
- Engine oil leakage.

Inspection of carbon canister solenoid valve

Execute the following procedures:

1. Remove the vacuum hose from the solenoid valve.
2. Start the engine and run it idling.
3. Put the finger on the far end of the vacuum hose to check the tube for vacuum feeling. If not, check if there are such problems:
   Vacuum hose is blocked.
   Vacuum hose is ruptured.
4. Blow air from the solenoid valve inlet, and the solenoid valve passage should not be circulating; if there is leak, replace the solenoid valve.
5. Then drive the solenoid valve with the automobile diagnosis device, and blow air from the solenoid valve inlet again, and the solenoid valve passage should be circulating; if it is not circulating, repair and eliminate the solenoid valve problem.

Carbon canister inspection

1. Check the filter on the carbon canister vent pipe; if there is clogging, rupture, deformation, etc., replace the filter.
2. Carbon canister appearance inspection: no rupture, deformation; if necessary, replace it.
3. Remove the carbon canister, and shake with hands; if there has abnormal sound, replace the canister.
4. Check the connection hose on the canister, and replace it if it's blocked or damaged.
5. Use the appropriate air source, to blow in one port on the carbon canister, there should be air outflow at the other two ports; otherwise, replace the carbon canister.

Operating Principle

System Overview

Emission control system is mainly composed of an exhaust emission control system, PVC (Positive Crankcase Ventilation) emission system, EVAP control system and fuel evaporation system.

Crankcase forced ventilation system

At the end of the effective engine combustion process, a certain mixture that not be burned under high pressure is leaked into the crankcase from the piston rings, which is called as “Channeling Gas”. The channeling gas contains nitrogen oxides, carbon monoxide and hydrocarbons. If the channeling gas is not exhausted, it can dilute the oil in the crankcase, and degrade the oil, resulting in premature wear of the engine parts. The channeling gas may escape into the atmosphere from the crankcase, resulting in the pollution. In order to avoid pollutant emissions and oil deterioration, positive crankcase ventilation system is used to get the crankcase blow-by back to the intake system, then the blow-by enters the combustion chamber from the intake manifold via PRV valve. Crankcase blow-by is mainly controlled by positive crankcase ventilation valve. Positive crankcase ventilation valve meters the volume of blow-by according to manifold vacuum signals. Positive crankcase ventilation valve allows some vacuum pressure to pass through the orifice inside the valve to reach a low pressure state in the crankcase. The blow-by air in the crankcase is then sucked into the intake system and burned during normal combustion. The volume of blow-by entering the intake manifold is precisely controlled to maintain the idling stability. The car must use a correct and properly calibrated positive crankcase ventilation valve. The relationship between blow-by flow and vacuum degree of engine manifold is shown in the following table:

Vacuum degree of manifold	Open degree of positive crankcase ventilation valve	Blow-by flow
Low	Wide	Much
High	Narrow	Little

Fuel evaporative emission (EVAP) control system

Fuel evaporation (EVAP) control system is to minimize the role of the fuel vapor into the atmosphere to reduce the vehicle emissions of hydrocarbons (HC). The system mainly includes:

- Activated carbon tank with evaporative emission (EVAP) control. It is used to temporarily store the fuel vapour, until the fuel vapour can be sent from EVAP controlled activated carbon tank into the engine for combustion.
- Fuel tank steam purification control system. The inhaled fresh air is sent into the inlet hole on the throttle body through the canister solenoid valve, where the purification is performed in the activated carbon tank.
- Fuel tank steam control system. When fuel vapour pressure in the fuel tank is above the set value of EVAP two-way valve, EVAP two-way valve will opened, to allow the fuel vapour to flow into EVAP controlled activated carbon tank.

Canister solenoid valve

The charcoal canister control valve consists of an electromagnetic coil, an armature, a valve, etc. The flow of air flowing through the canister control valve is related to the duty ratio of the electrical pulse output to the canister control valve on the one hand, and the pressure difference between the inlet and the outlet of the canister control valve on the other hand. When there is no electric pulse, the canister control valve is closed.

Evaporative emission carbon canister

The evaporative emission carbon canister is an emission control device containing activated carbon particles. The evaporative emission carbon canister is used to adsorb and store fuel vapor from fuel tank. The fuel vapor is always stored in carbon canister, when certain conditions are meet, the engine control module will power on the canister sewage solenoid valve, to allow the fuel vapor to enter into the engine cylinder for consumption.

The following conditions can lead to poor idle, loss of idle and poor control performance:

- The carbon canister solenoid valve does not action.
- The carbon canister is damaged.
- The hose is disconnected broken, or not connected with the proper pipeline.

Diagnostic Information and Procedures

Diagnosis Instructions

Before starting to diagnose a fault in the emission control system, familiarize yourself with the operating principle of the emission control system, and then start the system diagnostics, which helps to determine the correct troubleshooting steps in the event of a failure. More importantly, this also helps to determine whether the customer's situation belongs to normal operation.

Any troubleshooting of the emission control system should begin with the emission control system check, so as to instruct the service personnel to take the next logical step to troubleshoot. Comprehend and correctly use the diagnostic flow chart to shorten the diagnosis time and avoid the misjudgement.

General equipment

Digital universal meter
Thickness gauge
Ignition timing gun
Diagnostic equipment of vehicle

Visual Inspection

1. Confirm the problem of the customer.
2. Visually check whether there is any obvious mechanical or electrical damage sign.

Visual inspection table

Electrical	Electrical
• Fuel vapor line • Vacuum tube • Carbon canister • Crankcase ventilation valve • Canister solenoid valve	• Fuse • Harness or plug • Canister solenoid valve • Front oxygen sensor • Rear oxygen sensor • ECM

3. If the observed or proposed problem is obvious and its cause is identified, rectify the cause before proceeding with next step.
4. If for the problem, there are no obvious findings, then confirm the fault and refer to the symptom table.

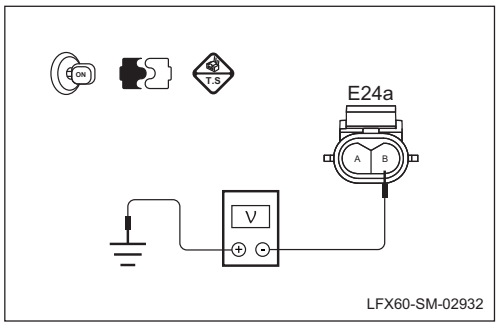
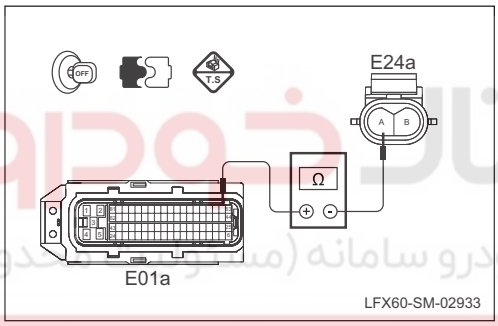
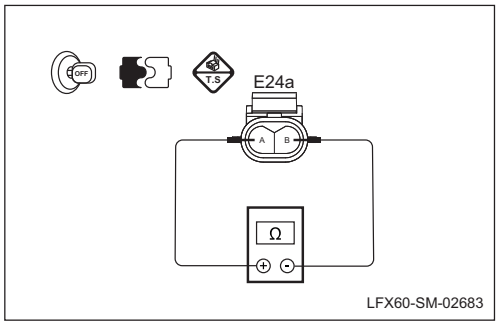
List of fault symptoms

If the vehicle fails, no trouble code is detected by the engine control module (ECM), and no significant fault location is found after visual inspection and general inspection, it is recommended that troubleshooting should be carried out according to diagnostic ideas and processes of the table below.

Symptom	Possible point of failure	Recommended Measures
The evaporative emission system is leaked	• Discharge pipe is ruptured	• Replace the discharge pipe
	• Carbon canister rupture	• Replace the canister
The evaporative emission system is clogged	• Vent line is blocked	• Clean and/or replace the vent line
	• Carbon canister line is blocked	• Clean the carbon canister pipe • Replace the canister
	• Carbon canister solenoid valve is blocked	• Replace the canister solenoid valve **Refer to: Replacement of canister solenoid valve**
The pressure in the crankcase is too high	• Oil-gas separator or hose is blocked or damaged	• Check if the components of oil-gas separator system are blocked (clean or install new components if necessary)
	• Engine components are worn or damaged	• Check the engine mechanical system
Out-of-service of Canister Solenoid Valve	• Harness or plug	**Refer to:Diagnostic process for carbon canister solenoid valve failing to work**
	• Canister solenoid valve	
	• ECM	

Diagnostic process for carbon canister solenoid valve failing to work

Test condition	Details/results/measures
1. Check the engine DTC.	
	A. Operate the ignition switch to turn the power to OFF and connect the diagnostic meter. B. Operate the ignition switch to turn the power to ON state. C. Turn on the diagnostic meter and check the engine system. Is there emission control fault code? →**Yes** **Refer to: Diagnostic trouble code (DTC) list. Perform DTC diagnostic procedure.** →**No** To step 2.
2. Execute the active testing of carbon canister solenoid valve.	
	A. Operate the ignition switch to turn the power to OFF and connect the diagnostic meter. B. Operate the ignition switch to turn the power to ON state. C. Open the diagnostic device, select the I/O function, and execute the carbon canister cleaning function. Does the carbon canister solenoid valve work properly? →**Yes** Intermittent failure. →**No** To step 3.
3. Check the fuse.	
	A. Operate the ignition switch to turn the power to OFF state. B. Check fuse FS14 in the electrical box of engine compartment. **Fuse rated capacity: 15A** Is it OK after checking? →**Yes** To step 4. →**No** Replace the fuse.

Test condition	Details/results/measures
4. Check the canister solenoid valve power supply line.	
	A. Operate the ignition switch to turn the power to OFF state. B. Disconnect the battery negative connector. C. Disconnect the canister solenoid valve harness plug E24a. D. Operate the ignition switch to turn the power to ON state. E. Connect the battery negative terminal. F. Use a multimeter to measure the voltage between terminal B of harness plug E24a of carbon canister solenoid valve and the reliable ground point. **Standard value:11 ~ 14V** Is the voltage normal? →**Yes** To step 5. →**No** Troubleshoot the canister solenoid valve power supply line. If necessary, replace the harness.
5. Check the carbon canister solenoid valve signal line.	
	A. Operate the ignition switch to turn the power to OFF state. B. Disconnect the battery negative connector. C. Disconnect the canister solenoid valve harness plug E24a. D. Disconnect the EMC harness plug E01a. E. Use a multimeter to measure the resistance between terminal A of harness plug E24a of carbon canister solenoid valve and terminal 64 of ECM harness plug E01a. **Standard value:Less than 5Ω** Is the resistance normal? →**Yes** To step 6. →**No** Check the carbon canister solenoid valve signal line for fault; and replace the harness, if necessary.
6. Check the canister solenoid valve.	
	A. Operate the ignition switch to turn the power to OFF state. B. Disconnect the battery negative connector. C. Disconnect the canister solenoid valve harness plug E24a. D. Measure the resistance between the canister solenoid valve terminal A and B with the multimeter. **Standard value:19~22Ω** Is the resistance normal? →**Yes** To step 7. →**No** Replace the canister solenoid valve. **Refer to: Replacement of canister solenoid valve**

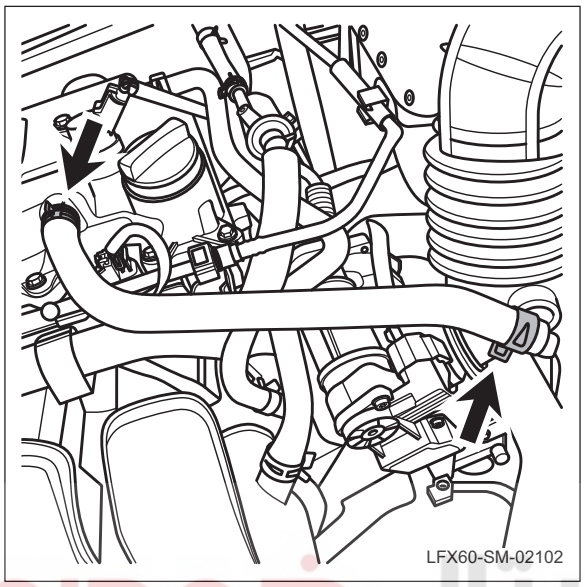
Test condition	Details/results/measures
7. Check ECM.	
	A. Replace ECM. **Refer to: Replacement of ECM** Confirm that the fault has been ruled out.

Removal and Installation

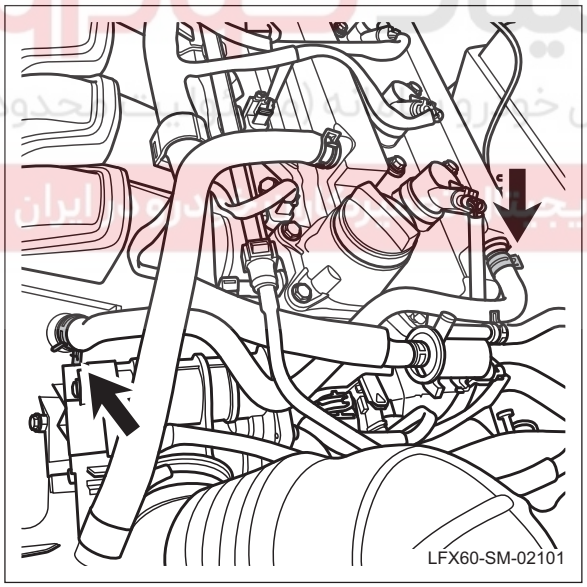
Replacement of crankcase vent pipe

Removal

1. Remove the crankcase vent pipe



(a). Remove the clamp from crankcase vent pipe 1, disconnect the connection, and remove the crankshaft vent pipe.



(b). Remove the clamp from crankcase vent pipe 2, disconnect the connection, and remove the crankshaft vent pipe.

Installation

1. Install the crankcase vent tube.

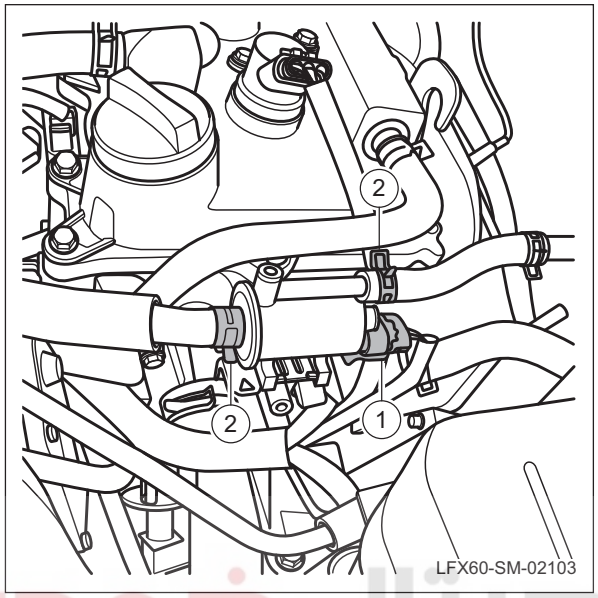
(a) The installation sequence is the reverse of the disassembly order.

Replacement of carbon canister solenoid valve

Removal

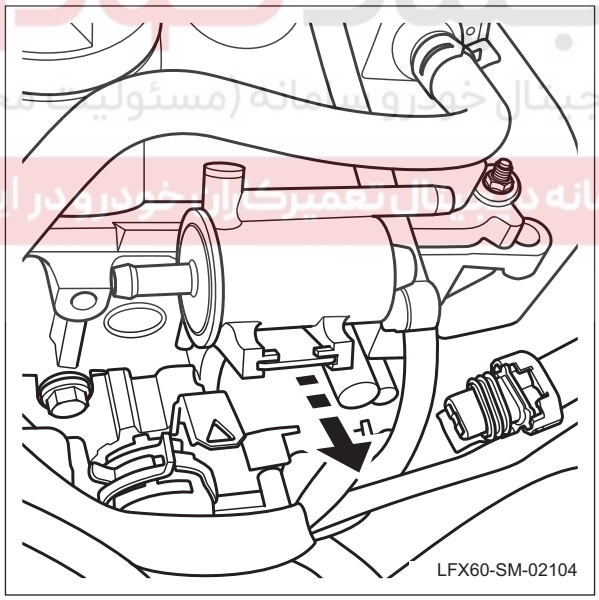
1. Disconnect the canister solenoid valve.

(a). Disconnect the battery negative connector.



(b). Disconnect the carbon canister solenoid valve harness plug 1.

(c). Remove the carbon canister solenoid valve hose clamp 2 and disconnect the hose.



(d). Remove the carbon canister solenoid valve.

Installation

1. Installation the canister solenoid valve.

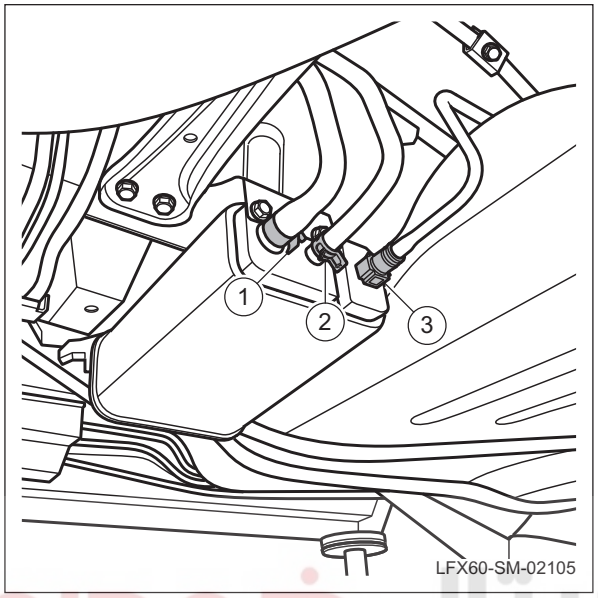
(a). The installation sequence is the reverse of the disassembly order.

Replacement of carbon canister

Removal

1. Remove the carbon canister.

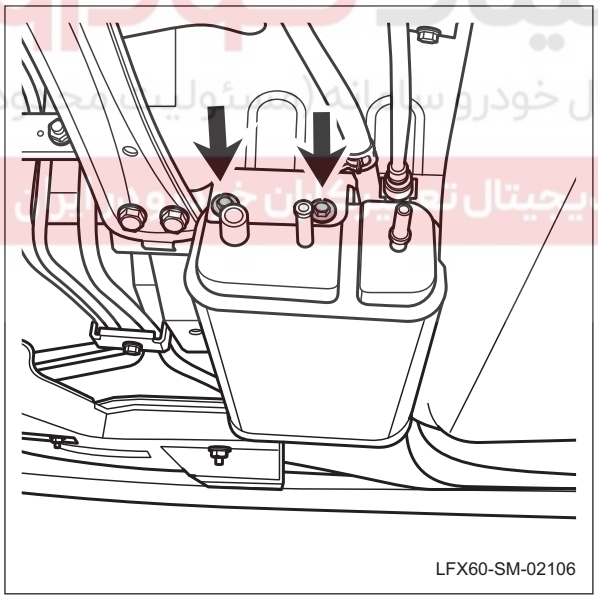
(a). Lift the vehicle. **Refer to the vehicle lift and support.**



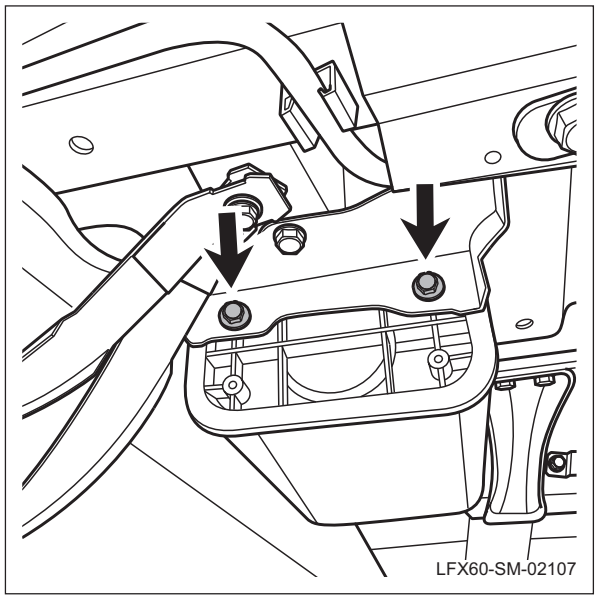
(b). Remove the carbon canister desorption tube.

(c). Remove the carbon canister adsorption tube 2.

(d). Remove the carbon canister ventilation tube 3.



(e). Remove the front fixing bolts from the carbon canister.



(f). Remove the rear fixing bolts from the carbon canister.
(g). Remove the canister assembly.

Installation

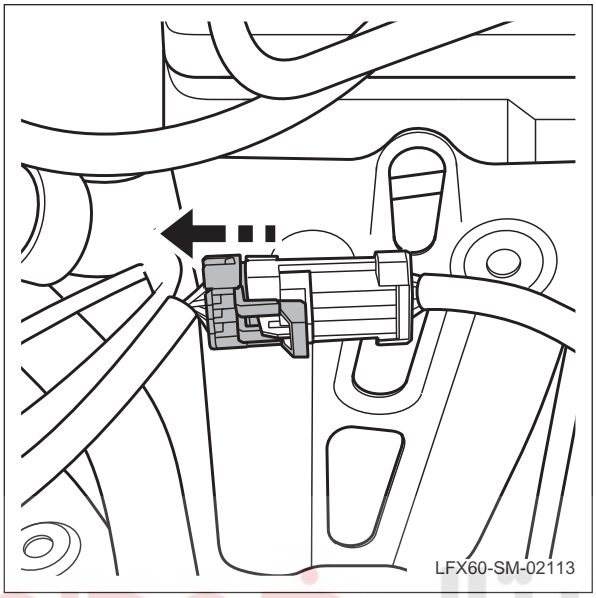
1. Installation of carbon canister.
(a). The installation sequence is the reverse of the disassembly order.

Replacement of Front HO2S

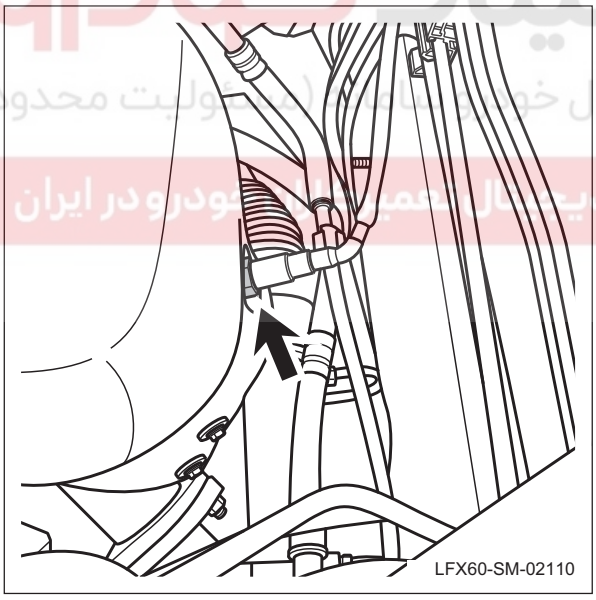
Removal

1. Remove the front oxygen sensor.

(a). Disconnect the battery negative connector.



(b). Disconnect the harness plug of front oxygen sensor.



(c). Remove the front oxygen sensor.

Installation

1. Installation the front oxygen sensor.

(a). The installation sequence is the reverse of the disassembly order.

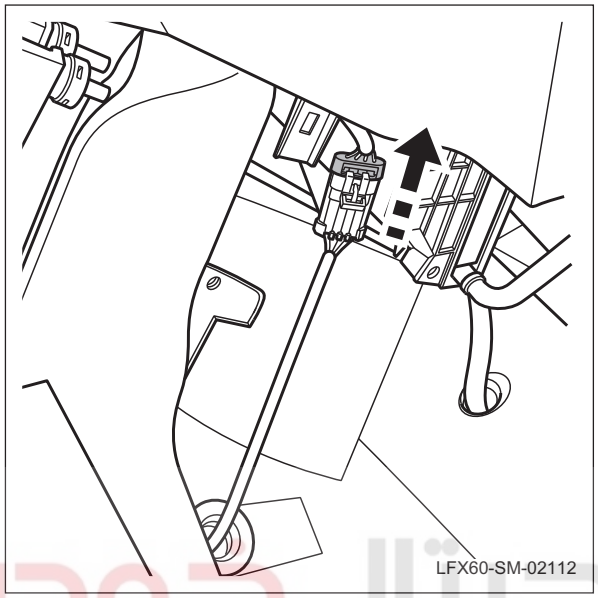
Replacement of Rear HO2S

Removal

1. Remove the rear oxygen sensor.

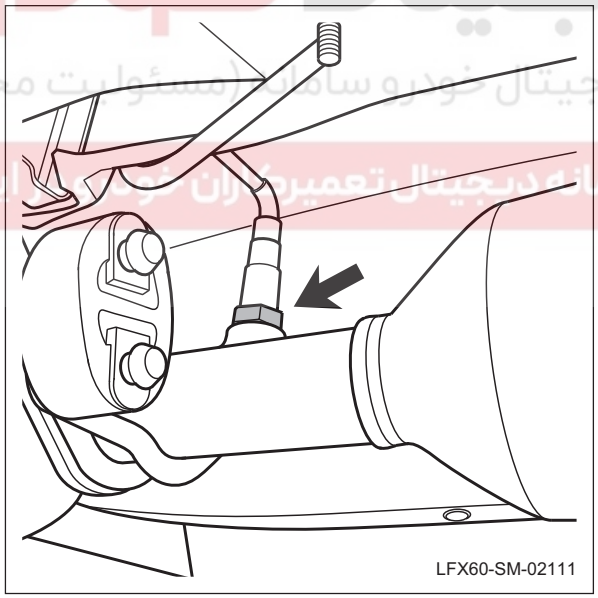
(a). Disconnect the battery negative connector.

(b). Remove the left decorative plate from the dashboard. **Reference: Replacement of the dashboard assembly.**



(c). Disconnect the harness plug of rear oxygen sensor.

(d). Lift the vehicle.



(e). Installation the rear oxygen sensor.

Installation

1. Installation the rear oxygen sensor.

(a). The installation sequence is the reverse of the disassembly order.