



## 02- Engine

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دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



# دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

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Lubrication system



## Lubrication System

### Technical specifications

#### General specifications

Engine oil grade	5W-30-SF or better	
Oil filling	4L	
Oil pressure	Idle speed	60~300kpa
	Calibrated speed	400~570kpa
Clearance for the oil pump driving rotor/driven rotor top:	Minimum clearance value	0. 06mm
	Maximum clearance value	0. 17mm
Clearance for the rotor (driving/driven) / oil pump housing top	0. 025-0. 062mm	
Clearance between the driven rotor and oil pump housing	0. 08~0. 16mm	

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## Torque Specifications

Name	Torque range	
	Metric (Nm)	British (lb-ft)
Oil sump drain bolt	44	32
Oil filter	27	20
Oil sump fixing bolt	10	7
Oil pump mounting bolt	11	8
Oil pump cover fixing screw	11	8
Oil pump relief valve plug	11	8
Oil pressure sensor	15	11
Set bolt of the flexible rail of timing chain	19	14
Timing chain fixed rail mounting bolts	13	10
Front enclosure mounting bolts	23	17
Tensioner hold-down nuts	11	8
Crankshaft pulley fixing bolts	138	102
Oil level stick guide fixing bolt	11	8
Engine front suspension bracket mounting bolts	52	38
Set bolt of the belt tension pulley	69	51
Tensioning pulley fixing nut	29	21
Generator fixing bolt (long bolt)	54	40
Generator fixing bolt (short bolt)	25	18
Cylinder head cover fixing bolt	11	8
Water pump assembly fixing bolt	11	8
Ignition coil fixing bolt	11	8



## Precautions

### Precautions

1. During the work of Lubrication system, be sure to start the work after the engine is cooled.
2. During the work, don't splash the oil on drive belt.
3. Collect the old engine oil and always maintain the service site clean.
4. Note the following several points for the use of sealant:
  - Use a scraper to thoroughly remove the residual sealant on the mounting surfaces (including the grooves of the applied surface of sealant, fixed bolts and bolt mounting holes) of oil pan and cylinder block.
  - When using sealant, wipe the applied surface of sealant and remove the water or other foreign matters.
  - Remove the foreign matters from sealant immediately, if any.

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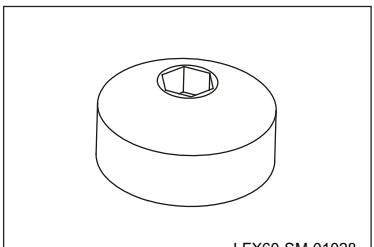
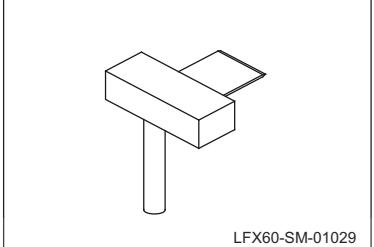
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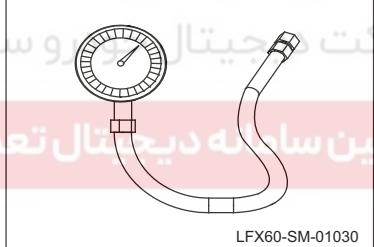
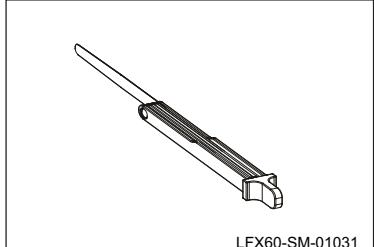


## Preparation

### Special maintenance tools

No.	Tool name	Tool figure	Tool code	Remarks
1	Oil filter puller	 LFX60-SM-01028	-	Remove and install the oil filter
2	Oil sump remover	 LFX60-SM-01029	-	Install the front crankshaft oil seal.

### General maintenance tools

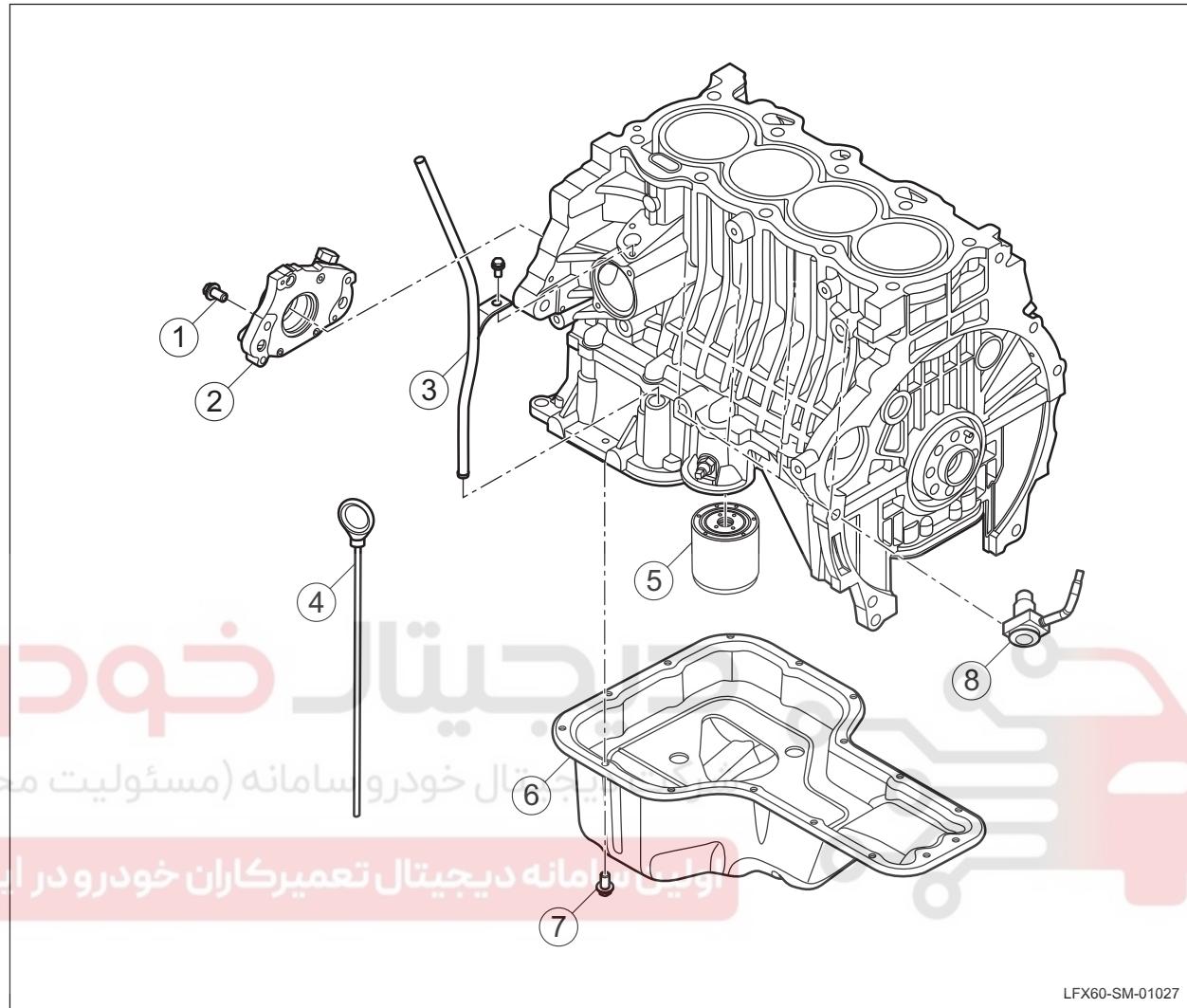
No.	Tool name	Tool figure	Tool code	Remarks
1	Oil manometer	 LFX60-SM-01030	-	To test engine oil pressure
2	Thickness gauge	 LFX60-SM-01031	-	Measure the part clearance

Lubrication system

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## Structure and installation location

### Component Location Plan

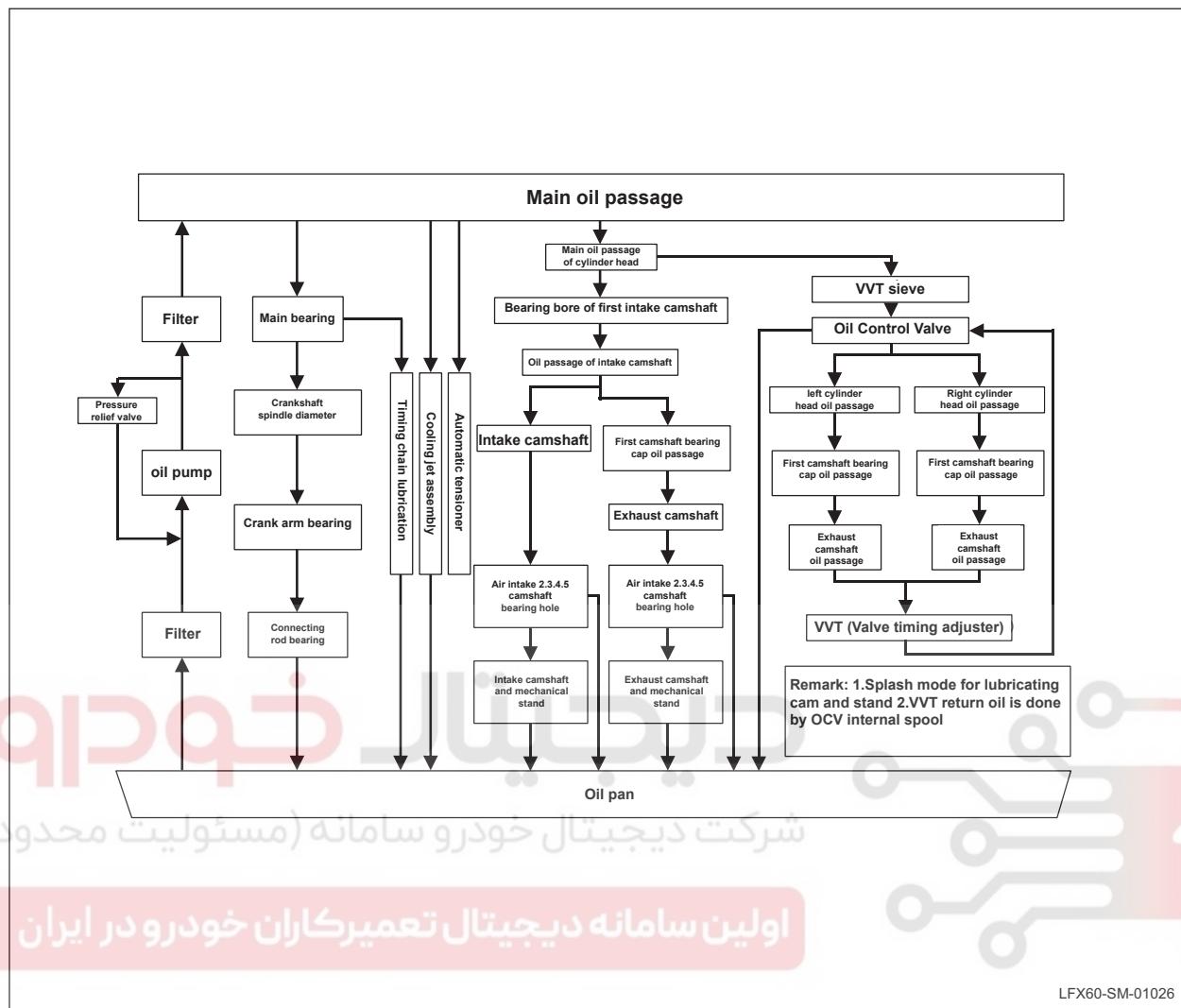


No.	Part Name
1	Bolt
2	Oil pump
3	Oil gauge duct
4	Oil dipstick

No.	Part Name
5	Oil filter
6	Oil Pan
7	Bolt
8	Cooling jet assembly



# Electrical Schematic Diagram

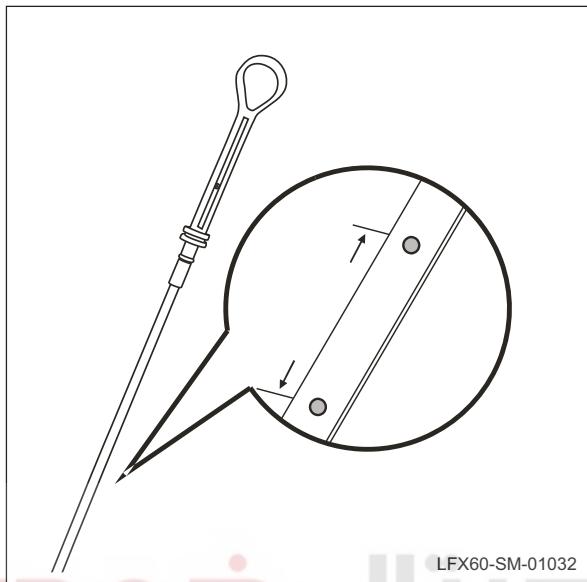


## General Inspection

### Engine oil, filter, oil pressure

#### Inspection

##### 1. Check the engine oil



(a). Check whether the engine oil level is between the upper and the lower level limits.

**Note:**

After the oil level is stable, remove the dipstick, wipe the oil on it with a clean cloth, insert it into its tube, and remove it for oil level check.

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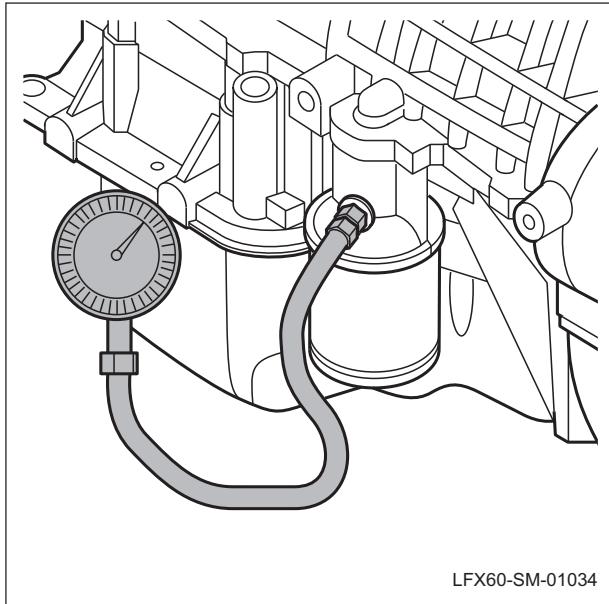
(b). Drain a little volume of oil into a container and check the oil quality.

**Note:**

Check if the engine oil deteriorates, changes in color or mixes with water (A.engine oil, B: water). If yes, replace it.

(c). Check the engine oil for poor quality, water entering, fading or thinning. If the oil quality is deteriorated, replace it.

## 2. Check of oil pressure



- Disconnect the connector of oil pressure sensor.
- Dismount the oil pressure sensor and install oil pressure gauge.
- Warm the engine and observe the oil pressure gauge.

**Oil pressure at idling:60~300kPa**

**Oil pressure at rated speed:400~570kPa**

**①Note:**

**If the pressure is not within the rated range, check the oil pump.**

- Remove the pressure gauge, install the oil pressure sensor and connect the sensor connector. Remove the pressure gauge

**Torque: 15Nm**

**①Note:**

**When installing the oil pressure sensor, coat the sensor threads with glue. It is prohibited to start the engine right after installing the oil pressure sensor. Wait a while before starting the engine.**

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## Operating Principle

### System Overview

The lubrication system mainly consists of the oil pump, oil strainer, oil filter, oil filter bracket, oil sump, oil pressure switch, etc. When the engine works, it continuously transmits sufficient clean oil with proper temperature to the friction surfaces of all the transmission parts. The oil forms films between the friction surfaces to realize liquid friction so as to reduce the friction resistance, decrease the power consumption and reduce the wearing of parts. In this way, the engine can work more reliable and durable. Use the oil pressure switch to monitor the oil pressure at real time to avoid the engine from serious damage.

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### Oil pump

The oil pump is independently installed on the timing chain shell and the driving gear is installed on the crankshaft. Because the oil pump gear and the oil pump driving gear on the crankshaft engage together, the oil pump starts to work when the crankshaft rotates.

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## Diagnostic Information and Procedures

### Diagnosis Instructions

Before trouble-shooting, first understand and get familiar with the working principle of lubrication system. This is helpful to determine the correct procedures of trouble-shooting when the trouble occurs. More important, it is also helpful to determine if the status described by the client is normal operation.

Any trouble-shooting for the lubrication system shall start from the inspection for the lubrication system, then guide the maintenance personnel to take next logic procedure to perform trouble-shooting. Comprehend and correctly use the diagnostic flow chart to shorten the diagnosis time and avoid the misjudgement.

### General equipment

Digital multimeter
Diagnostic equipment of vehicle
Jumper wire
Oil pressure testor

### Visual Inspection

1. Confirm the customer's question.
2. Visually check for obvious signs of mechanical or electrical damage.

### Visual inspection table

Mechanical
<ul style="list-style-type: none"> <li>• Engine oil</li> <li>• Oil pressure switch</li> <li>• Oil filter</li> <li>• Oil pump</li> <li>• Strainer</li> </ul>

3. If the observed or raised problem is the evident and the cause has been found, ensure to fix this fault before proceeding with the 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

Symptom	Possible Cause	Recommended Measures
Oil abnormal consumption	• Oil seal or other parts leak	• Check and replace the leaking part.
	• Ventilation system of crank case in trouble	• Check and replace the damaged part on the ventilation system of crank case.
	• Combustion chamber abnormal consumption	• Engine mechanical fault
Oil pressure warning lamp fails	• Oil pressure alarm	Refer to: Trouble-shooting procedure for oil pressure warning lamp failing
	• Oil pressure alarming circuit	
	• Instrument cluster	
Oil pressure warning lamp normally on	• Oil pressure low	Refer to: Trouble-shooting procedure for oil pressure warning lamp normally on
	• Oil pressure alarm	
	• Oil pressure alarming circuit	
	• Instrument cluster	

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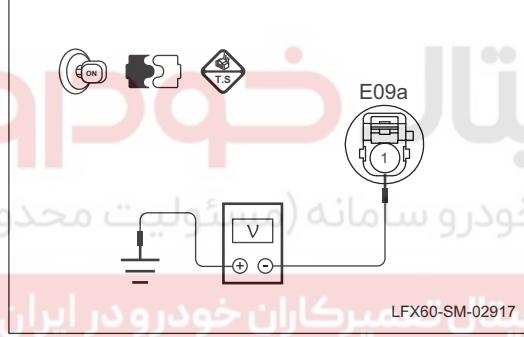


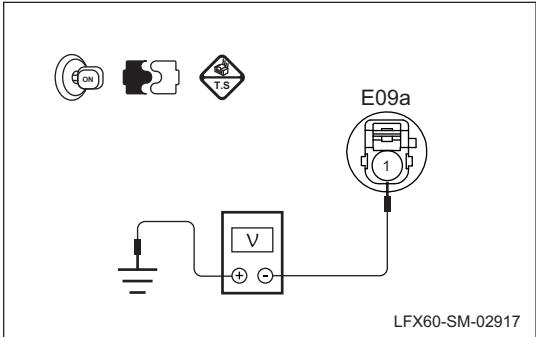
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### Trouble-shooting procedure for oil pressure warning lamp failing

Test condition	Details/results/measures
1. Check the oil pressure alarm.	<p>A. Operate the ignition switch to turn the power to OFF state.</p> <p>B. Disconnect the battery negative connector.</p> <p>C. Disconnect the oil pressure alarm plug E09a.</p> <p>D. Connect the battery negative terminal.</p> <p>E. Operate the ignition switch to turn the power to ON state.</p> <p>F. Ground No.1 terminal of oil pressure switch connector E09a to the reliable grounding with a jumper wire.</p> <p>Is the oil pressure warning lamp on?</p> <p>→Yes</p> <p>Replace the oil pressure alarm.</p> <p>→No</p> <p>To step 2.</p>
2. Check the input voltage of oil pressure beeper.	 <p>A. Operate the ignition switch to turn the power to OFF state.</p> <p>B. Disconnect the battery negative connector.</p> <p>C. Disconnect the oil pressure alarm plug E09a.</p> <p>D. Connect the battery negative terminal.</p> <p>E. Operate the ignition switch to turn the power to ON state.</p> <p>F. Measure the voltage between No.1 terminal of oil pressure beeper E09a and the reliable grounding with a multimeter</p> <p><b>Standard value: 11 ~ 14V</b></p> <p>Is the voltage normal?</p> <p>→Yes</p> <p>To step 3.</p> <p>→No</p> <p>To step 4.</p>

Test condition	Details/results/measures
<p>3. Check the power supply circuit of oil pressure beeper.</p> 	<p>A. Operate the ignition switch to turn the power to OFF state.      B. Disconnect the battery negative connector.      C. Disconnect the oil pressure alarm plug E09a.      D. Disconnect the instrument cluster harness plug I29.      E. Measure the resistance between No.1 terminal of oil pressure beeper plug E09a and No.15 terminal of the combination instrument harness connector I29 with a multimeter</p> <p><b>Standard value: Less than 5Ω</b></p> <p>Is the resistance normal?      → Yes      To step 4.      → No      Check if the power supply circuit of oil pressure beeper is in trouble. Replace the harness if necessary.</p>
<p>4. Check the instrument cluster.</p>	<p>A. Replace the instrument cluster.      Refer to: Replacement of instrument cluster assembly      Confirm the fault is eliminated</p>



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### Trouble-shooting procedure for oil pressure warning lamp normally on

#### ① Note:

Before trouble-shooting, make sure the oil level, viscosity and quality are normal, if necessary, replace or add the oil.

Test condition	Details/results/measures
1. Check the oil pressure.	<p>A. Check the engine oil.          B. Check the oil pressure.          Is it OK after checking?          →Yes          To step 5          →No          To step 2.</p>
2. Check the oil strainer.	<p>A. Check if the sieve of oil strainer gets deformed or blocked.          Is it OK after checking?          →Yes          To step 3.          →No          Replace the oil strainer.</p>
3. Check the oil pump.	<p>A. Check the oil pump.          Is it OK after checking?          →Yes          To step 4,          →No          Replace the oil pump.          Refer to: Oil pump</p>
4. Check the fit clearance of bearing shell	<p>A. Decompose main bearing shell and connecting rod shell.          B. Check the fit clearance between the main bearing shell and connecting rod shell.          Is it OK after checking?          →Yes          To step 5,          →No          Repair the fit clearance of bearing shell to normal.</p>

## Lubrication system



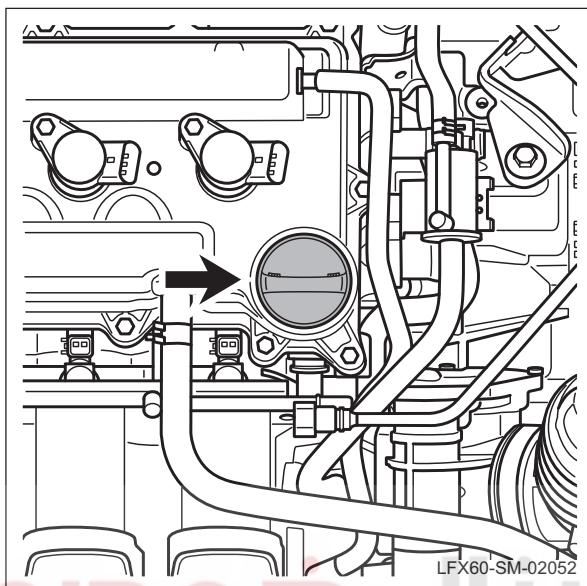
Test condition	Details/results/measures
5. Check the circuit of oil pressure beeper.	<p>A. Operate the ignition switch to turn the power to OFF state.      B. Disconnect the battery negative connector.      C. Disconnect the oil pressure alarm plug E09a.      D. Measure the resistance between No.1 terminal of oil pressure beeper plug E09a and the reliable grounding with a multimeter</p> <p><b>Standard value: 10 MΩ or higher</b></p> <p>Is the resistance normal?</p> <p>→ Yes To step 6. → No Check the oil pressure beeper circuit. If necessary, replace the harness.</p>
6. Check the oil pressure alarm.	<p>A. Operate the ignition switch to turn the power to OFF state.      B. Disconnect the battery negative connector.      C. Disconnect the oil pressure alarm plug E09a.      D. Replace the oil pressure beeper.</p> <p>Is the troubleshooting successful?</p> <p>→ Yes Replace the oil pressure alarm. → No To step 7.</p>
7. Check the instrument cluster.	<p>A. Replace the instrument cluster.</p> <p><b>Refer to: Replacement of instrument cluster assembly</b> Confirm the fault is eliminated</p>

## Removal and Installation

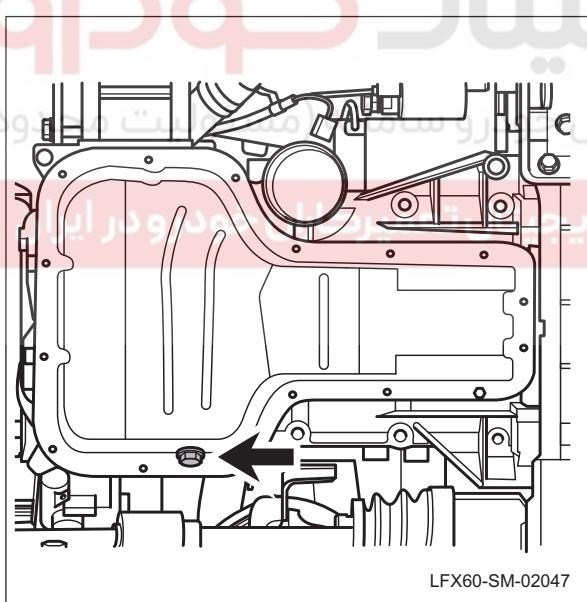
### Removal and Installation

#### Removal

##### 1. Discharge



(a). Undo the cover of oil filler port.



(b). Lift the vehicle  
 (c). Place oil collector under discharge bolt of oil sump.  
 (d). Dismantle discharge bolt to discharge engine oil.

##### 2. Filling

(a). Install the oil drain bolt of oil sump.

**• Note:**

If necessary, replace the oil drain bolt and gasket ring.

(b). Lower the vehicle.  
 (c). Fill in the engine with oil of the type and amount specified in the table.

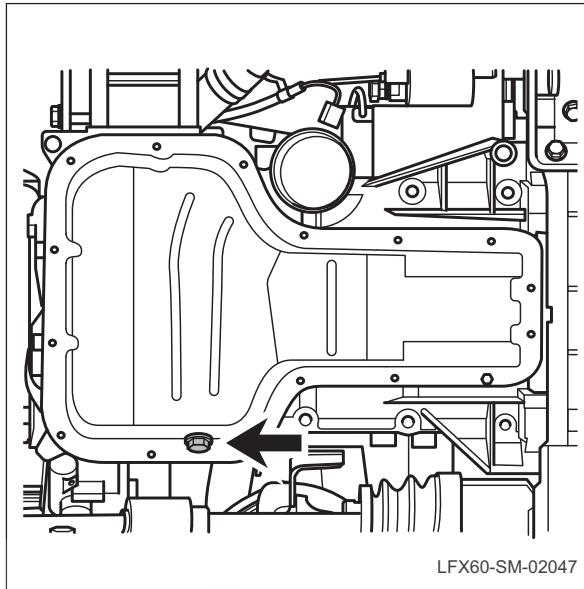
## Lubrication system



## Oil filter

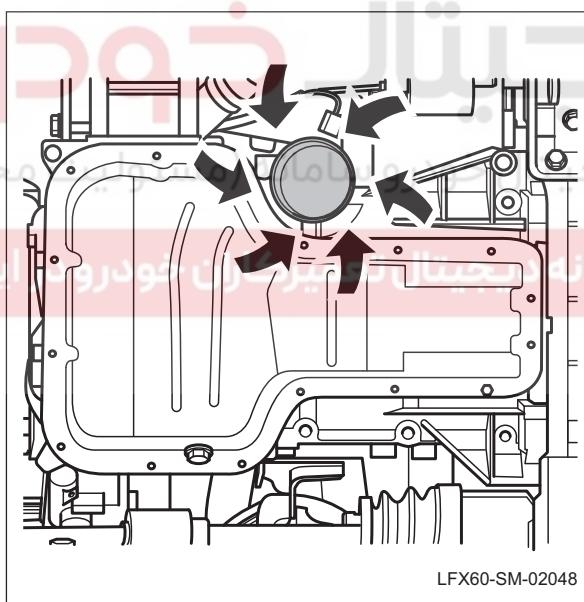
## Removal

## 1. Dismount the oil filter.



- (a). Lift the vehicle
- (b). Remove the oil drain plug to drain the oil from the engine.

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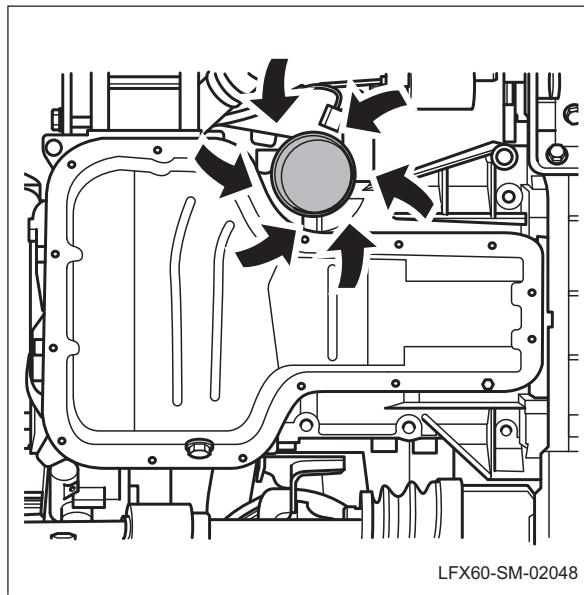
- (c). Use the remover of oil filter to dismount the oil filter.

**① Note:**

- After the engine is cooled, perform the operation.
- During operation, prepare a piece of rag to clean up spilled or splashed engine oil.
- Do not splash the engine oil onto the drive belt.
- Thoroughly clean the oil splashed on the engine or body.
- If necessary, replace the oil drain bolt and gasket ring.

## Installation

## 1. Install the oil filter.



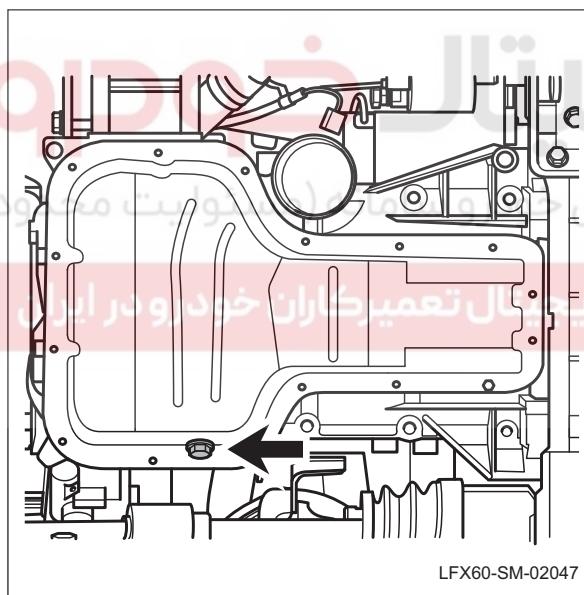
(a). Use the remover of oil filter to install the oil filter.

**Note:**

Use the genuine oil filter.

Before installing the oil filter, coat the sealer of oil filter with lubricant.

When installing the oil filter, first put it on the base manually until the O-ring completely seats on the base, then use the filter remover to tighten it.



(b). Install the oil drain screw plug.

(c). Fill in proper oil.

(d). Start the engine and confirm there is no leakage.

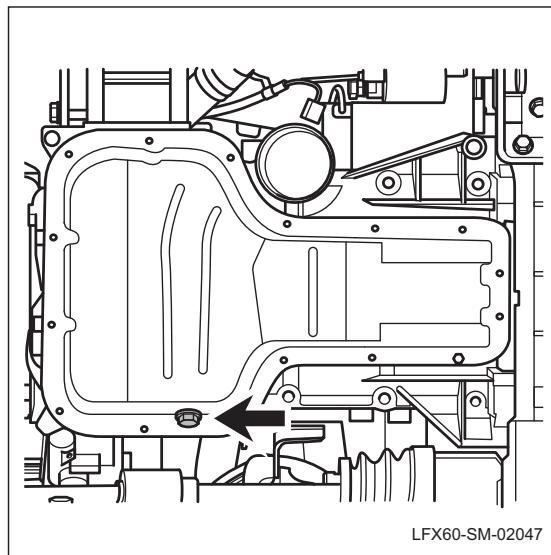
## Lubrication system



## Replacement of oil sump assembly

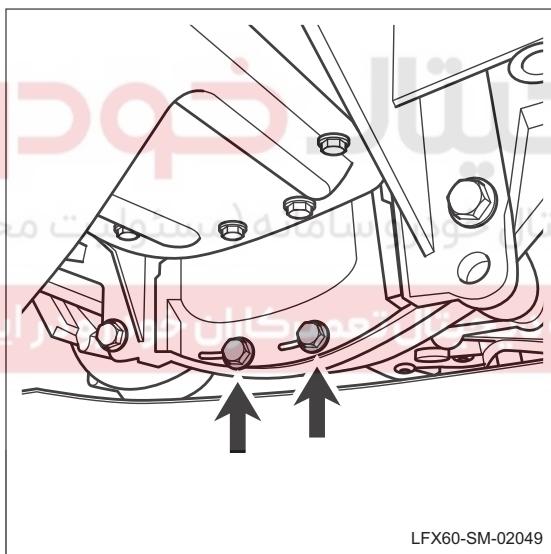
## Removal

## 1. Dismount the oil sump assembly.

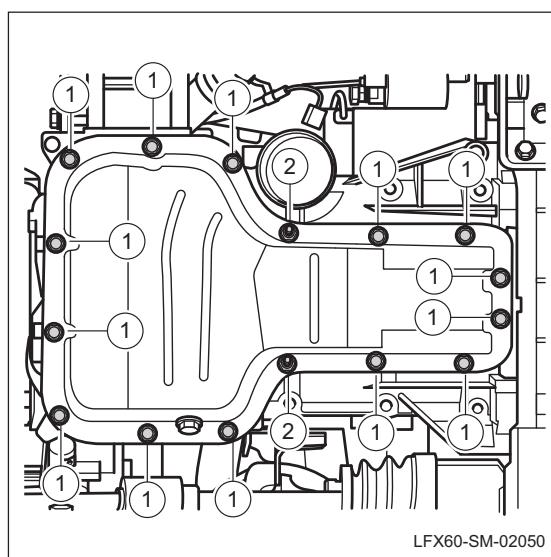


- (a). Lift the vehicle
- (b). Remove the oil drain plug to drain the oil from the engine.

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- (c). Dismount the tap bolts of flywheel baffle and detach them.



- (d). Dismount the tap bolt 1 and grip nut 2 of oil sump assembly.

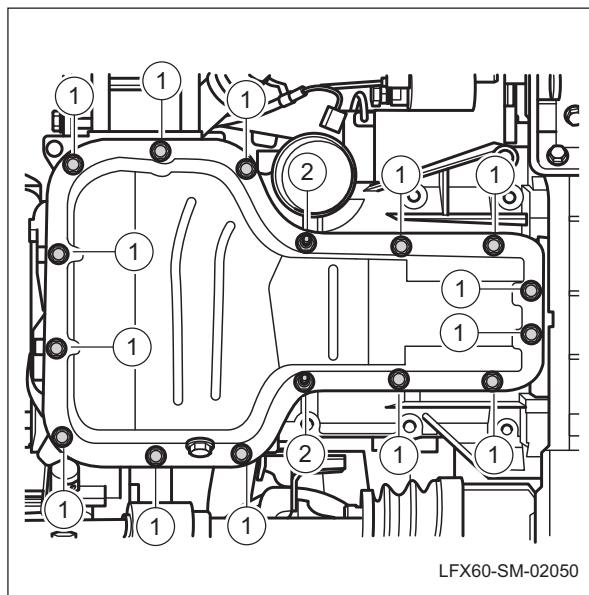
- (e). Detach the oil sump assembly.

**Note:**

There an opening between the oil pan and crankcase, from which the oil pan can be separated from the crankcase.

## Installation

### 1. Install the oil sump assembly.

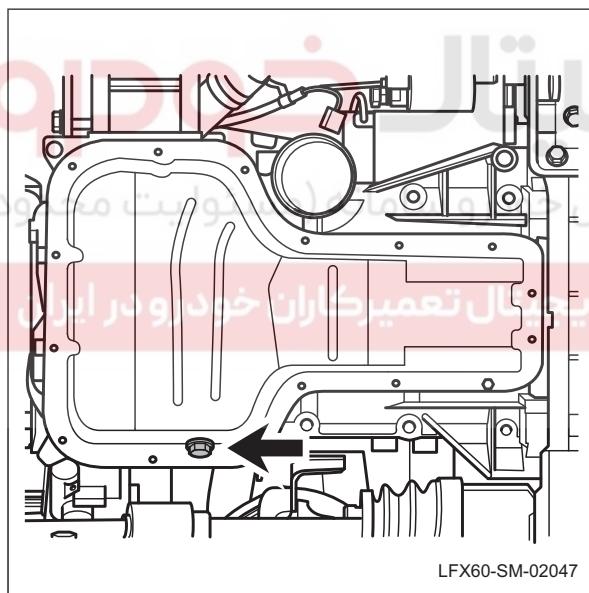


(a). Install the oil sump by alternately tightening the tap bolts

**Note:**

Coat the sealant on the interface between the cylinder and oil sump before installing the oil sump. Make sure to install it before the sealant gets hard.

Torque: 10Nm



(b). Install the oil drain screw plug.  
 (c). Lower the vehicle.  
 (d). Fill in the lubricant for the engine according to the standard.  
 (e). Check each joint and there should not be any leakage.

## Lubrication system

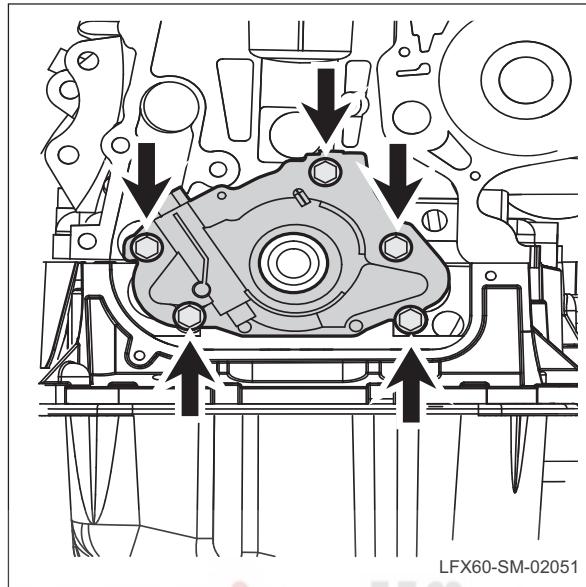


## Oil pump

## Removal

## 1. Dismount the oil pump.

(a). Disconnect the battery negative terminal.



(b). Remove the camshaft cover. Refer to: Replacement of the camshaft cover.

(c). Dismount the oil sump. Refer to: Replacement of oil pan.

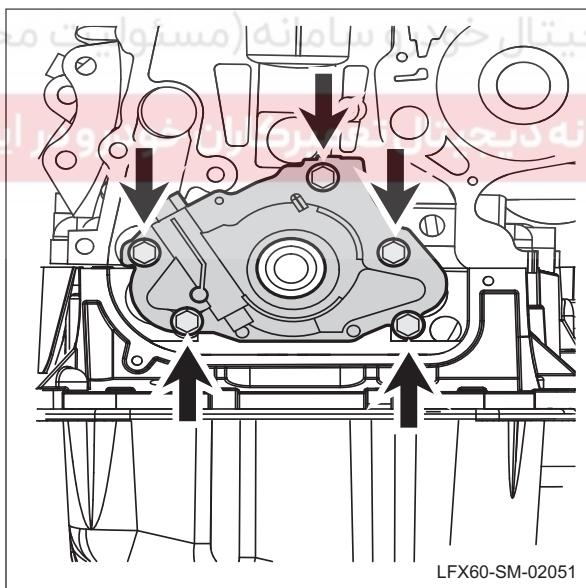
(d). Remove the timing chain and sprocket components. Refer to: Replacement of timing chain and sprocket assembly.

(e). Dismount the tap bolts of oil pump and detach the pump.

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## Installation

## 1. Install the oil pump.



(a). Install the oil pump and pad to the position. Put on the bolts and tighten them.

## Torque: 11Nm

(b). Install the subassembly of timing chain and sprocket. Refer to: Replacement of timing chain and sprocket assembly.

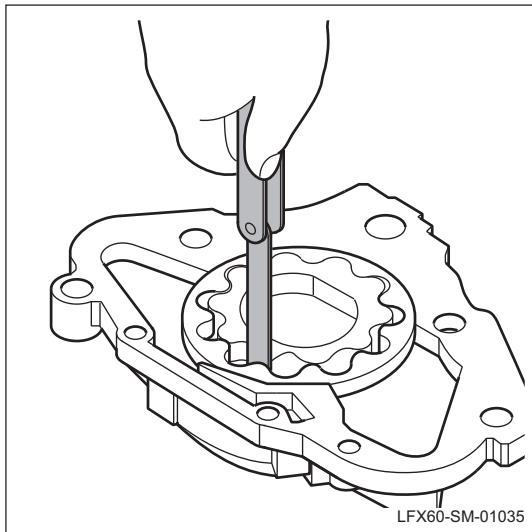
(c). Install the oil sump. Refer to: Replacement of oil pan.

(d). Install the camshaft cover. Reference: Replacement of camshaft cover.

(e). Connect the battery negative terminal.

## Inspection

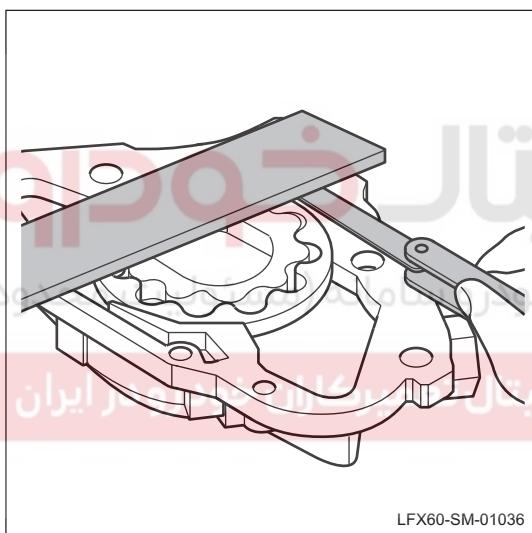
## 1. Check the subassembly of oil pump.



(a). Use a thickness gauge to measure the top clearance between the drive and driven rotators as shown in the diagram. If it is more than the maximum value, replace the oil pump.

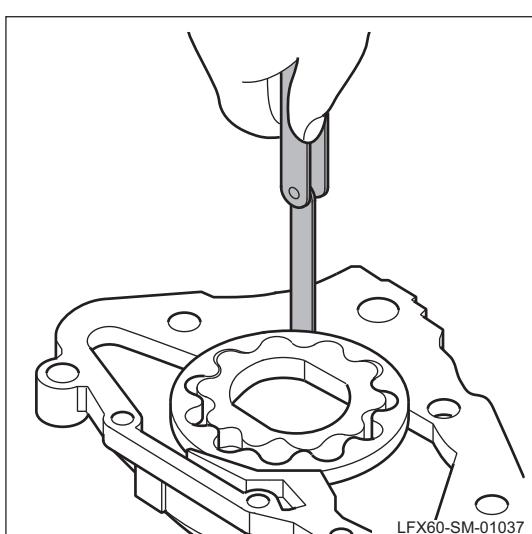
**Minimal gap: 0.06mm**

**Maximum gap: 0.17mm**



(b). Use a thickness gauge to measure the top clearance between the 2 rotors and the housing of oil pump as shown in the diagram. If it is more than the maximum value, replace the oil pump.

**Standard gap: 0.025 ~ 0.062mm**

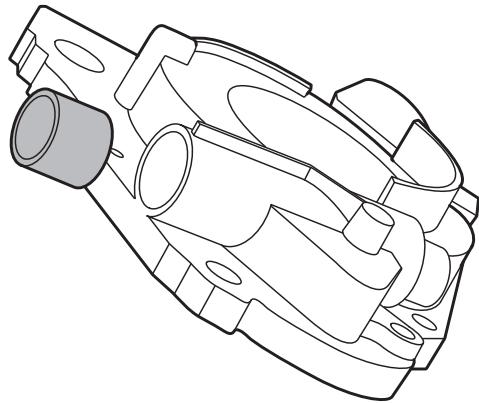


(c). Use a thickness gauge to measure the top clearance between the driven rotator and the housing of oil pump as shown in the diagram. If it is more than the maximum value, replace the oil pump.

**Standard gap: 0.08 ~ 0.01in**

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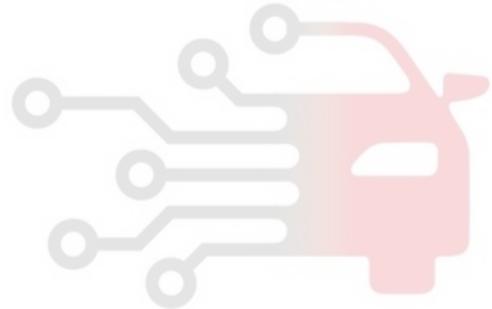
(d). Coat a layer of clean oil on the pressure relieve valve of oil pump. Check and confirm if the oil valve can slide into the valve hole by its own weight. If not, replace the oil pump.

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