LUBRICATION SYSTEM

1538-01/1538-08/1538-48/1548-01/1548-35/9210-01/

GENERAL INFORMATION

OVERVIEW AND OPERATING PROCESS

CONFIGURATION AND FUNCTIONS

REMOVAL AND INSTALLATION

LUBRICATION SYSTEM 1538-01

GENERAL INFORMATION

1. SPECIFICATIONS

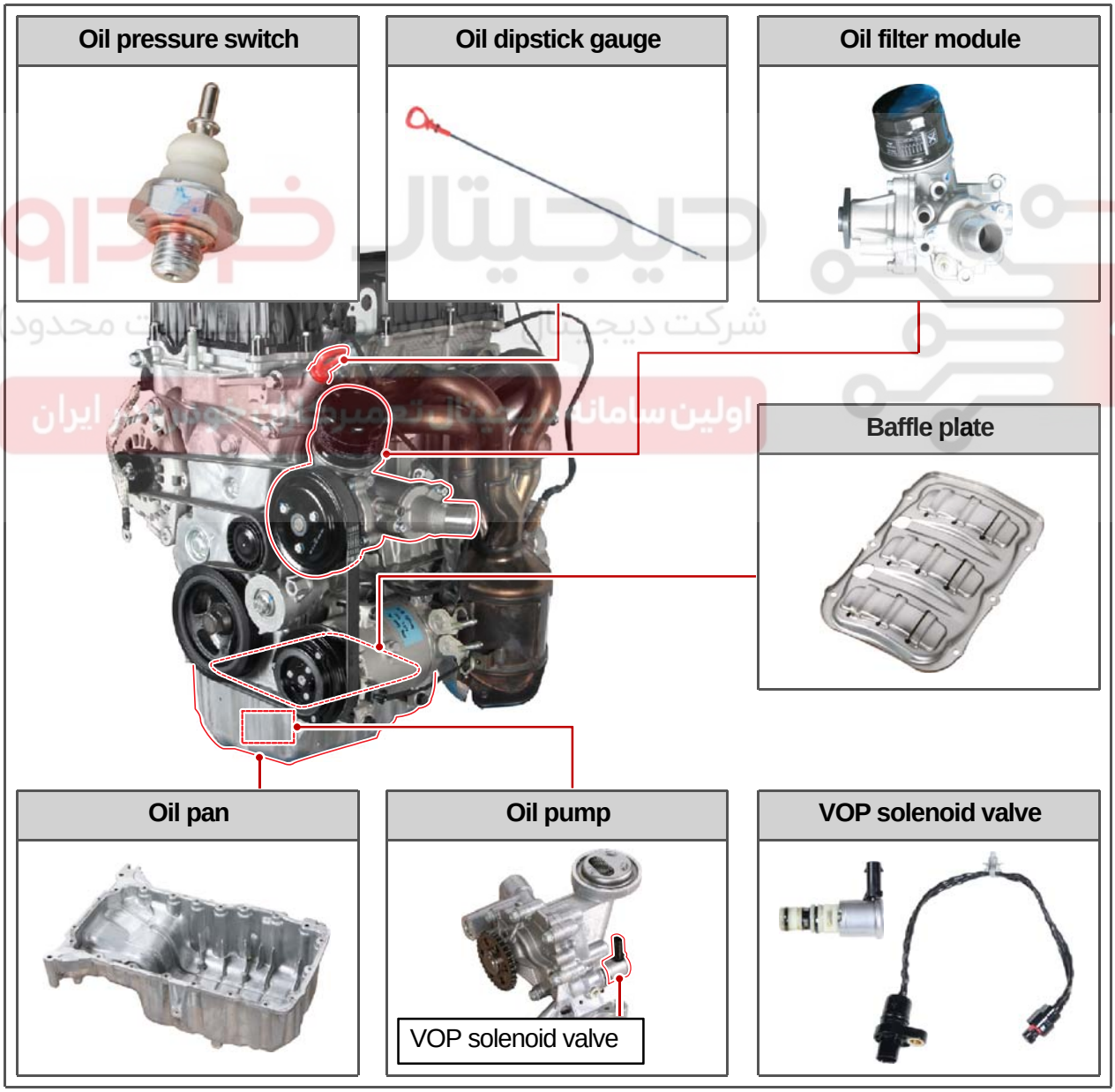
Category		Specifications	Remarks
Oil pump	Lubrication	Gear pump, forced circulation	
	Type	Vane type + Solenoid valve (VOP)	
	Number of sprocket teeth	33	
	Pressure valve opening pressure	7.0 ± 1 bar	
	VOP pressure (at about 140°C)	2.0 bar (SOL. ON)	
		4.0 bar (SOL. OFF)	
Oil filter module	Type	Water and thermostat housing + Oil filter module	
	Oil flow rate	About 40 L/min (80°C)	
	Bypass valve opening pressure	1.0 ± 0.2 bar	-
	Non-return valve opening pressure	0.2 ± 0.04 bar	
	Filter service interval	- When changing engine oil - After 15,000 km of driving (After initial 10,000 km of driving) - 12 months after previous replacement	
Engine oil	Specifications	- MB 229.51 SAE 5W-30 - SN/GF-5 SAE 5W-20	
	Type	1. SK ZIC SYMC 5W-30 2. SK ZIC SYMC FE 5W-20	
	Capacity	4.0 ℓ (4.5 ℓ at initial fill)	
	Service interval	After initial 10,000 km of driving → At every 15,000 km of driving or 12 months	

OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

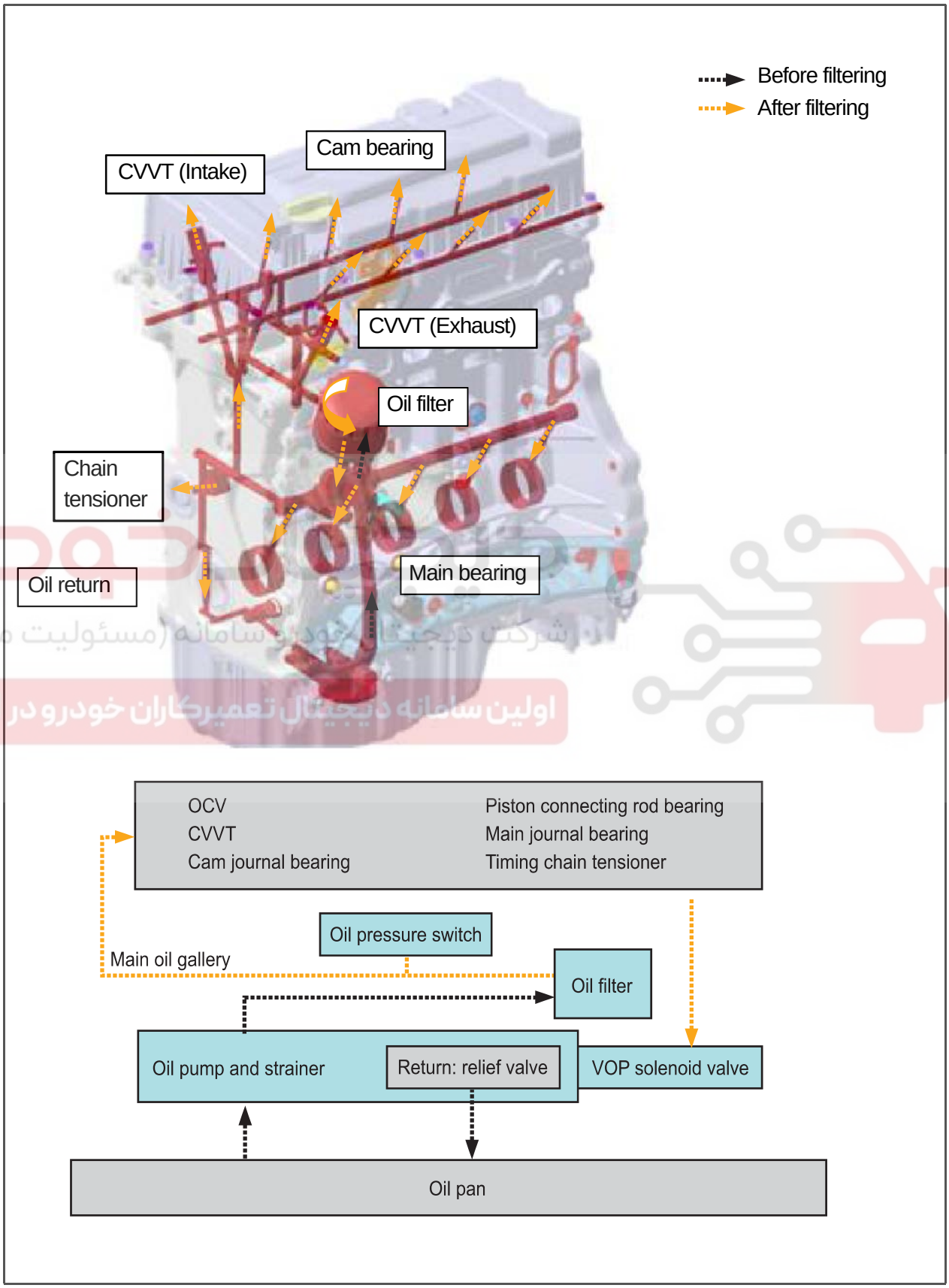
The lubrication system supplies oil to various parts of the engine that require lubrication to reduce friction, wear, heat on the surfaces in contact with each other. When the engine is running, frictional heat is generated by moving parts. If this heat builds up, the bearing can be stuck. The lubrication system creates an oil film on each contact surface of the two moving parts to convert solid friction to liquid friction in order to reduce wear and prevent the temperature from increasing. The lubrication system is equipped with a variable oil pump (VOP) which improves the fuel economy in low/moderate speed range and ensures the reliability in high speed range.

2. COMPONENTS



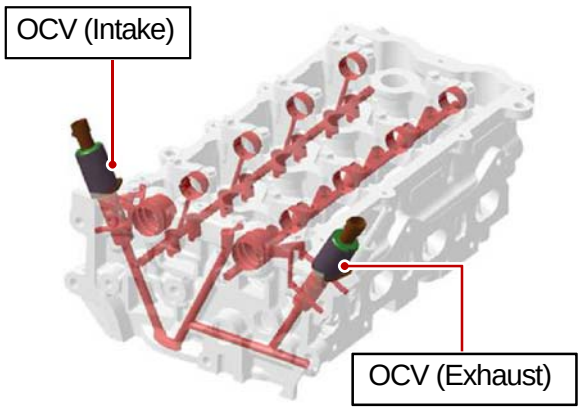
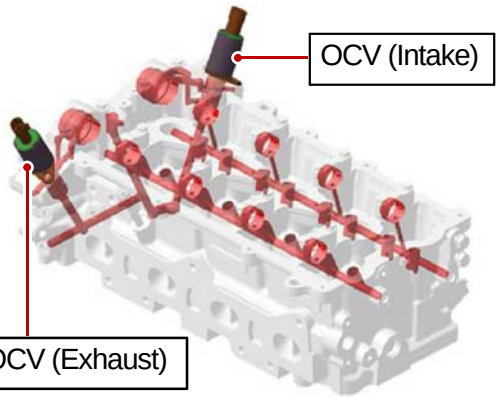
Modification basis	
Application basis	
Affected VIN	

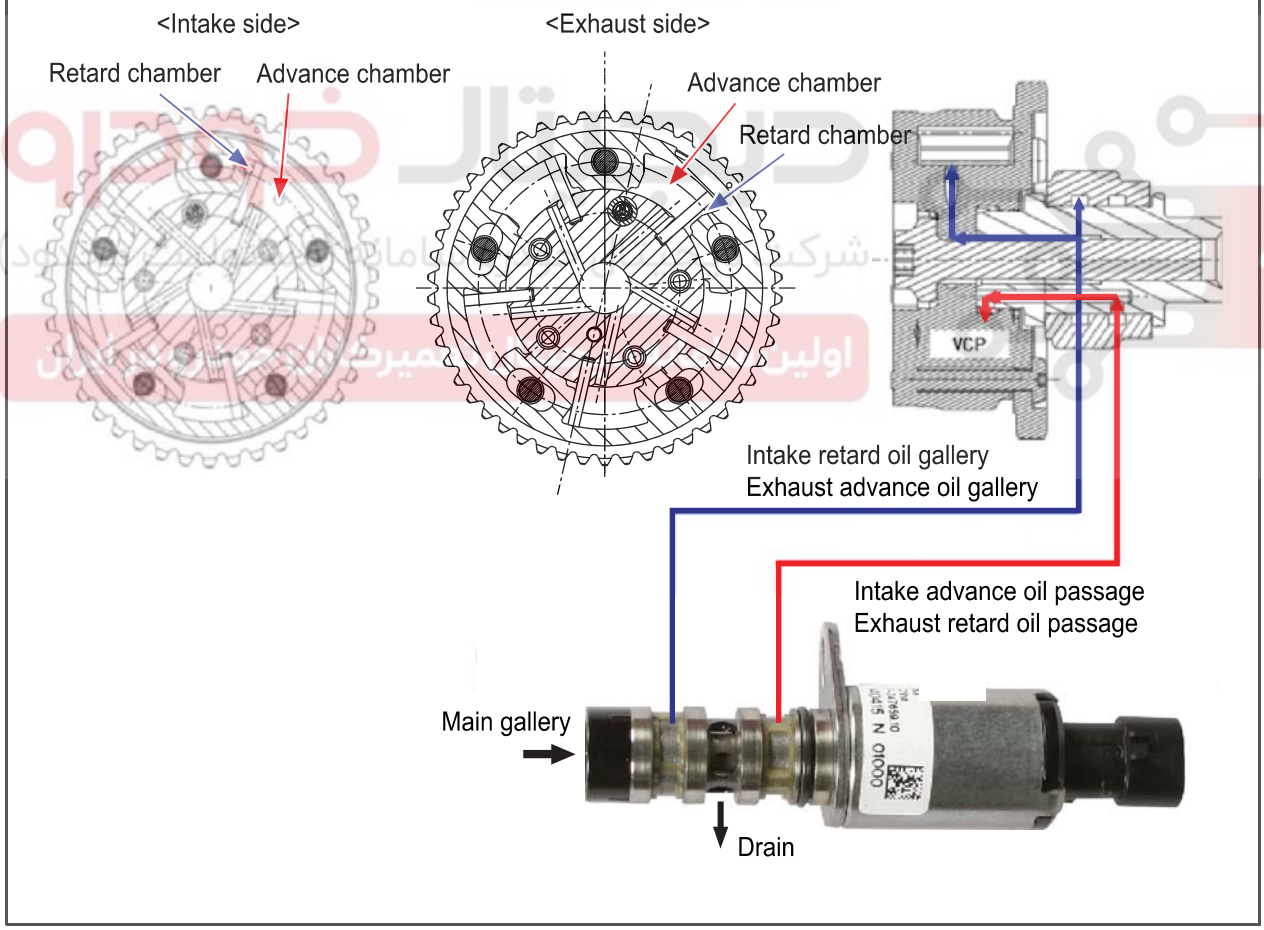
3. SYSTEM DIAGRAM



Modification basis	
Application basis	
Affected VIN	

▶ **CVVT and camshaft oil passages**

Front view	Rear view
	



NOTE

Refer to "ENGINE CONTROL" section in "G16DF ENGINE" chapter for detailed operation process of the CVVT.

Modification basis	
Application basis	
Affected VIN	

CONFIGURATION AND FUNCTIONS

S.G.N. 9210-01 ENGINE OIL

1) Functions

The main functions of the engine oil are lubricating and cooling the important parts of the engine. It is essential for smooth operation of the engine.

▶ Reducing wear

Friction is the resistance created between the surfaces of two moving objects that are in contact with each other.
No matter how smooth the finished surface looks, the surface has bumps when viewed under a microscope. These bumps get stuck on and break each other when directly contact with other surfaces. This results in wear. Even if no bump exists on the surface, mechanical wear will occur when the surface contacts with other surface and moves in relation to that surface. The engine oil supplied to the frictional surfaces creates an oil film on each contact surface and converts the solid friction to liquid friction to reduce wear.

▶ Cooling

The frictional energy is converted to heat energy. And the pistons and cylinders are heated up by the combustion gases. The engine oil absorbs and dissipate the heat from these components.

▶ Sealing

The cylinders are sealed by the piston ring fitted to the pistons. The engine oil penetrates through the small gaps between the piston ring and seating surfaces of the piston and completes the sealing. The oil seal prevents pressure leaks and return flow of the combustion gases.

▶ Rust proofing

The engine oil creates a thin film on the metal surfaces and prevents the surfaces from contacting with air, water, or corrosive gas which causes rust and corrosion.

▶ Cleaning

The engine oil circulates in the engine by the pressure from the oil pump. The oil keeps the frictional surfaces clean by transporting the metal particles, oxides, and carbides generated from the surfaces.

2) Properties

The properties of the engine oil greatly affect the performance and efficiency of the engine. The properties of oil differ depending on the crude oil and refining process used.
However, most coolants in the market are mixed with various additives to improve the performance.

3) Required properties

Basically, the properties of engine oil differ by usage. In general, the following properties are required.

▶ Cleaning effect

Products of the combustion (e.g. carbon) and degradation products of oil contaminate the engine causing problems related to poor lubrication which reduces the service life of the engine. Therefore, the inside of engine needs to be kept clean and oil with proper cleaning effect is recommended.

▶ Oxidation stability

The engine is driven for a long time and hot. Therefore oil with high oxidation stability is recommended. Oxidation of oil generates harmful substances which increase oil viscosity. This causes poor lubrication resulting in severe corrosion or wear.

▶ Anti-corrosion

Products of the combustion (e.g. carbon) and degradation products of oil cause corrosion of the metal surfaces. Therefore, oil with anti-corrosion additives is recommended.

▶ Anti-foaming

Bubbles in oil cause deterioration of oil pump, poor circulation of oil, and poor lubrication, resulting in malfunctions.

▶ Viscosity index

Viscosity is a measure of oil thickness. Oil with high viscosity forms thick oil film which supports high load. However, too high viscosity increases internal friction of lubricant which indicates increased resistance, resulting in increased power loss. Alternatively, too low viscosity cannot form the oil film which is essential for wear reduction.
The most important factor that determines the viscosity of lubricants is temperature. In general, the viscosity of a lubricant decreases as temperature increases. The amount of viscosity change in relation to temperature is called "Viscosity index". The viscosity change of the oil with high viscosity index is lower than that of the oil with low viscosity index. The engine temperature varies greatly so oil with high viscosity index is recommended.

4) Consumption

The engine oil is used up for various reasons. The amount of oil consumption is affected by oil viscosity, oil quality, and driving conditions. The amount of consumption increases especially when the engine is new or driven at high rpm. When the engine is new, operation of the pistons, piston rings, and cylinders is not optimized. Therefore, more oil will be used up. Check the engine oil level each time you fill the tank during the first 5,000 km as much as possible. Make sure that the engine oil level is within the specified range before long journeys.

Modification basis	
Application basis	
Affected VIN	

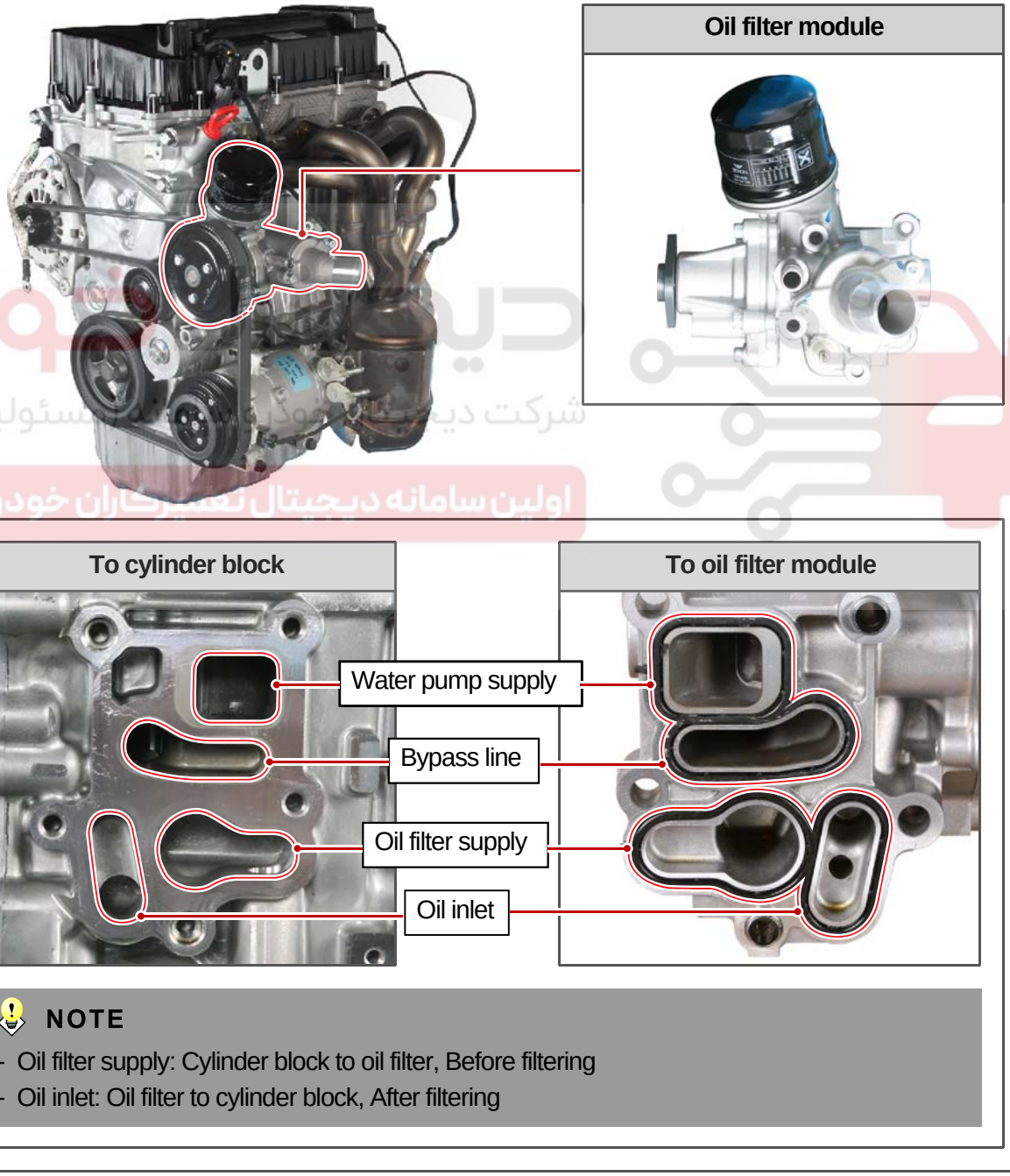
S.G.N. 1548-01

OIL FILTER MODULE

1) Overview

The oil filter module consists of oil filter, water pump, thermostat, and oil pressure switch. The oil filter removes the solid foreign materials (combustion residue, dust, metal particles, etc.) from the engine oil and maintains lubrication performance of the oil during the service life.

2) Mounting Location and Components

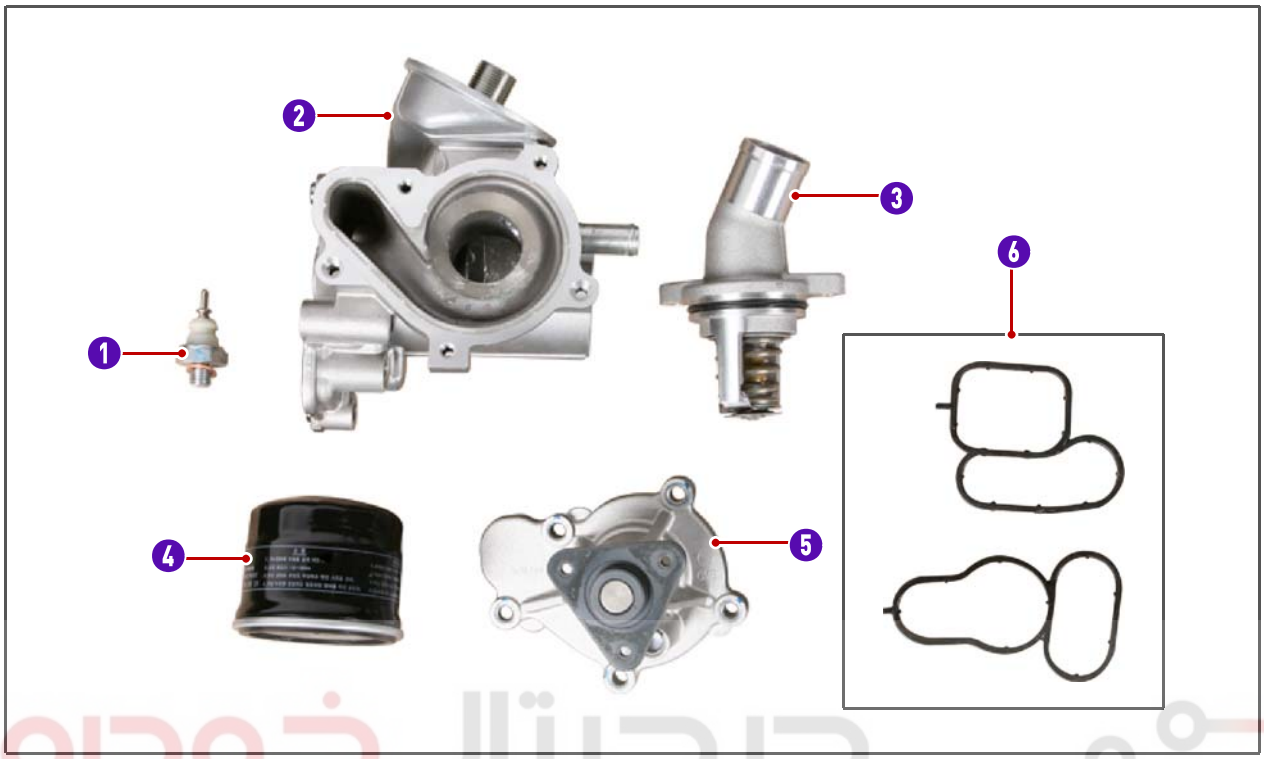


NOTE

- Oil filter supply: Cylinder block to oil filter, Before filtering
- Oil inlet: Oil filter to cylinder block, After filtering

Modification basis	
Application basis	
Affected VIN	

▶ Exploded view



No.	Designation
1	Oil pressure switch
2	Oil filter housing
3	Thermostat
4	Oil filter
5	Water pump
6	Oil filter module gasket

Modification basis	
Application basis	
Affected VIN	

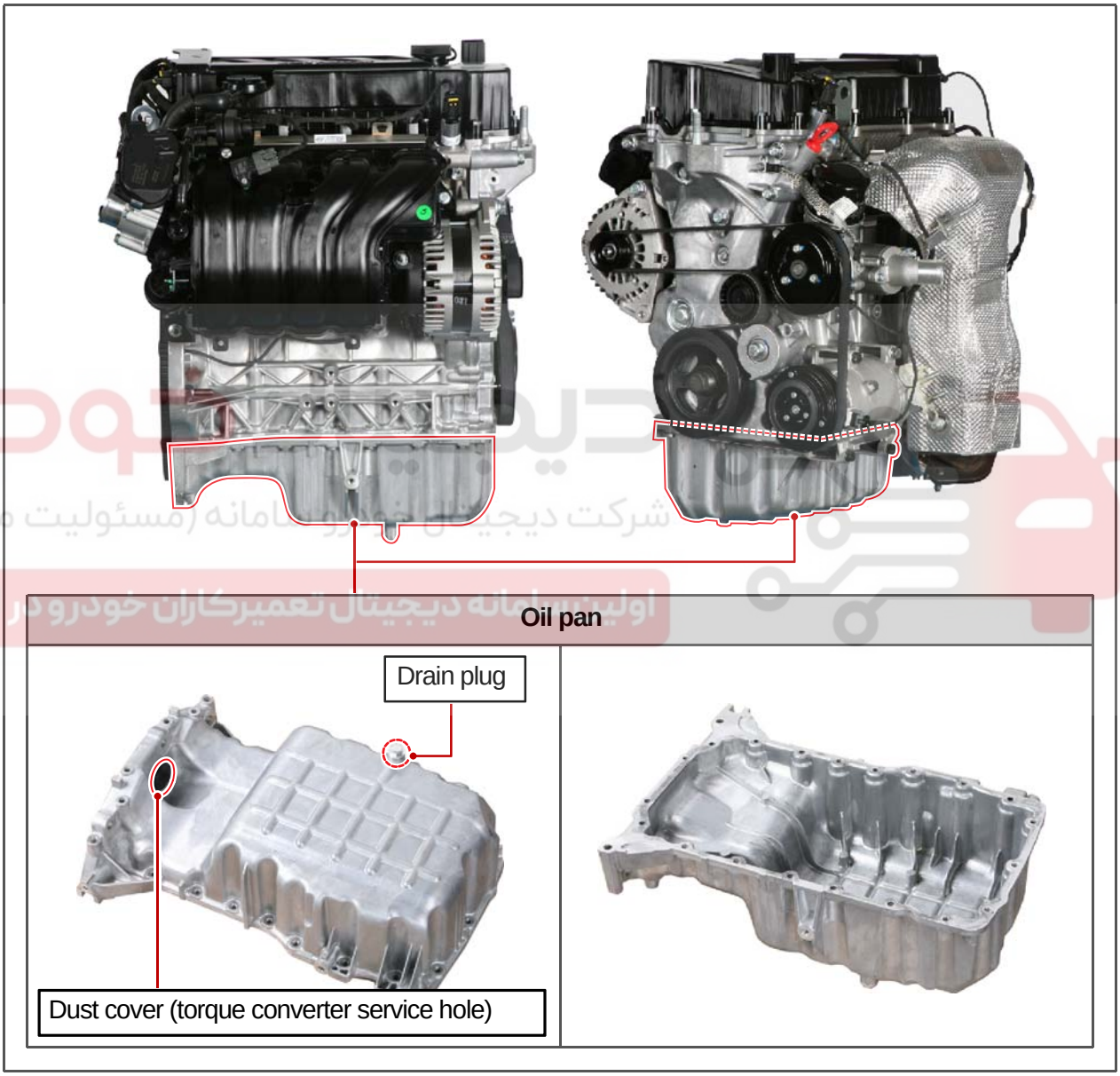
S.G.N. 1538-08

OIL PAN

1) Overview

The oil pan is a container in which engine oil is stored, and consists of oil pump and baffle plate.

2) Mounting Location and Components



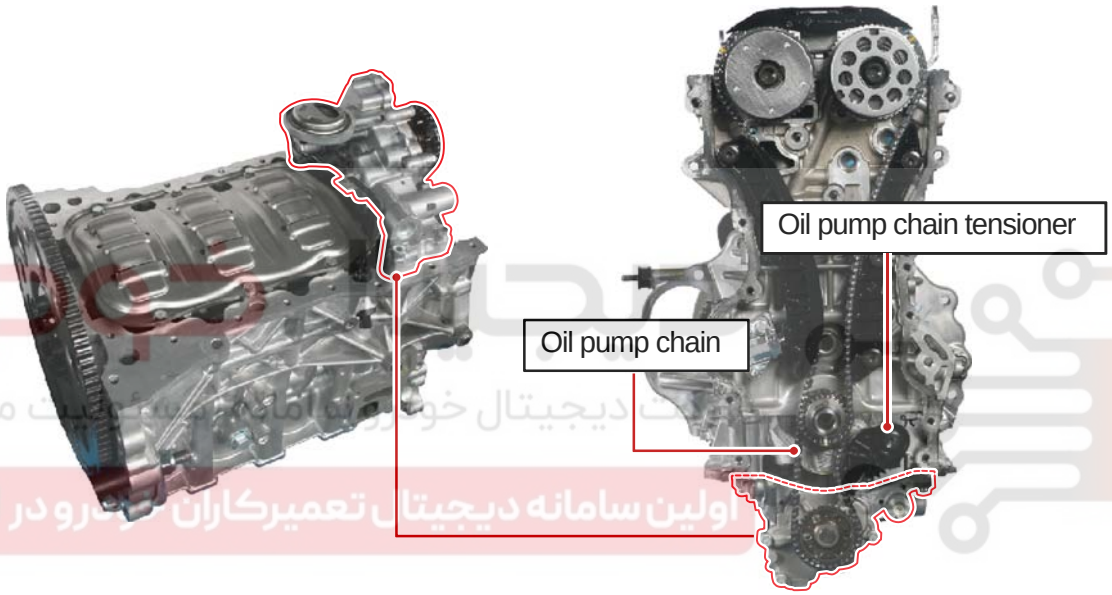
S.G.N. 1538-01

OIL PUMP

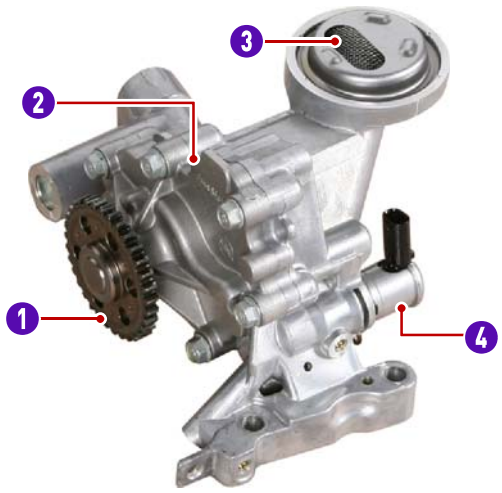
1) Overview

The oil pump is connected to the oil pump chain and circulates the engine oil. The engine oil stored in the oil pan is forced toward the components such as oil filter, bearings, pistons and valves to lubricate them. The lubrication system is equipped with a variable oil pump (VOP) which improves the fuel economy in low/moderate speed range and ensures the reliability in high speed range.

2) Mounting Location and Components



Oil pump



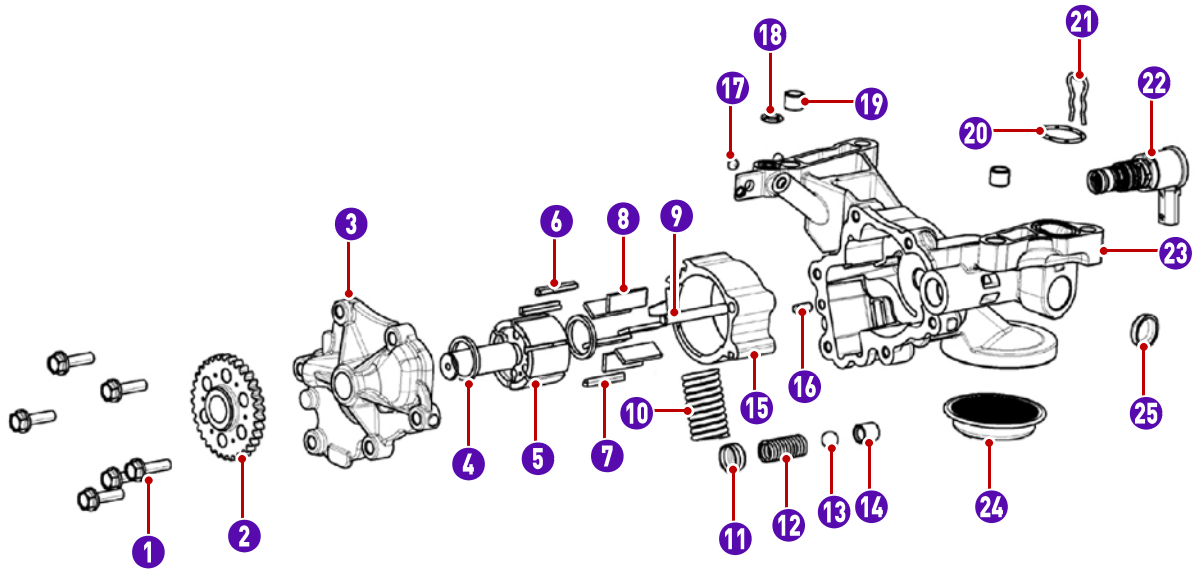
1. Oil pump sprocket
2. Oil pump housing
3. Oil pump strainer
4. VOP solenoid valve

NOTE

Refer to "ENGINE CONTROL" section in "G16DF ENGINE" chapter for detailed operation process of the VOP.

Modification basis	
Application basis	
Affected VIN	

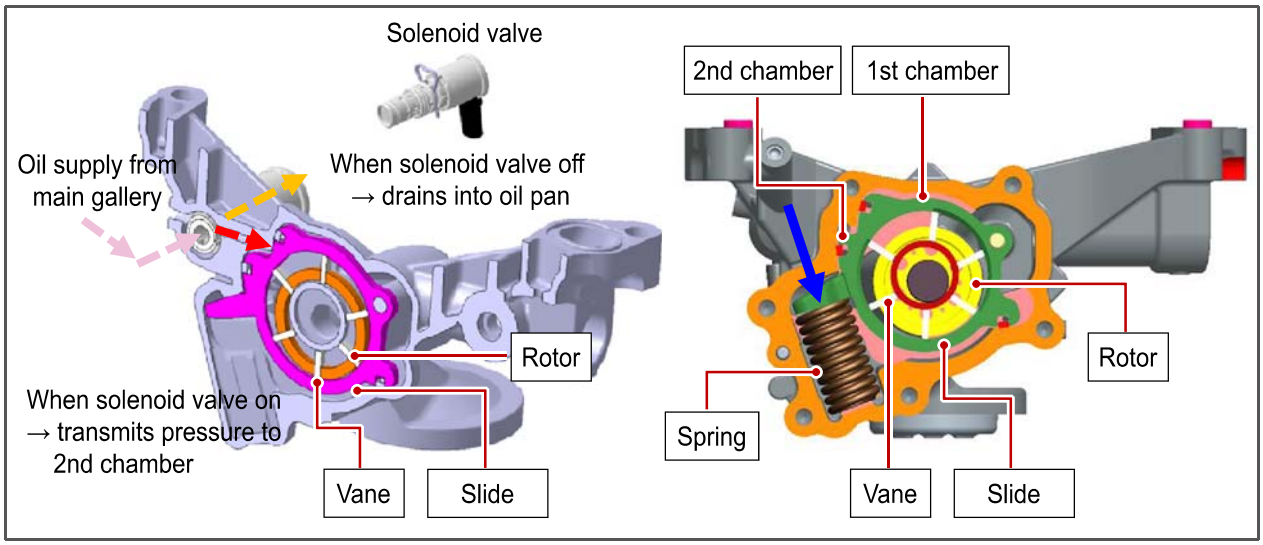
Exploded view



1. Bolt
2. Sprocket
3. Cover
4. Vane ring
5. Rotor with shaft assembly
6. Slide seal support
7. Slide seal
8. Vane
9. Pivot pin
10. Slide spring
11. OPV plug
12. OPV spring
13. OPV ball
14. OPV insert
15. Slide
16. Dowel pin
17. Cap sealing
18. O-ring
19. Knock bushing
20. Outlet gasket
21. Retainer
22. VOP solenoid valve
23. Housing
24. Oil screen assembly
25. Cap plug

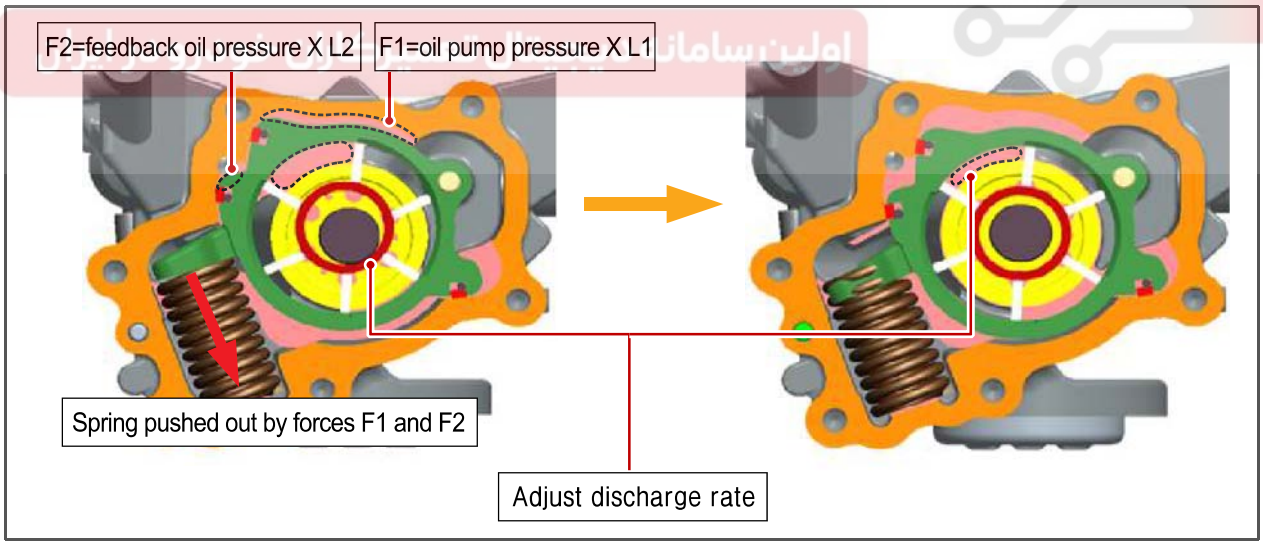
Modification basis	
Application basis	
Affected VIN	

3) Operating process



▶ When the VOP solenoid valve is ON

If the VOP solenoid valve is activated, then the valve will close the drain passage to the oil pan so that the pressure can be sent to the 2nd chamber (F2). The discharge pressure of the oil pump will be sent to the 1st chamber (F1). Therefore, the sum of both pressure (F1+F2) will be applied to the slide connected to the spring and this force will compress the spring. At this time, the whole slide will move to increase the gap with the rotor as shown in the right figure. Then the oil pressure will decrease because of the changed volume ratio.



▶ When the VOP solenoid valve is OFF

If no power is supplied to the VOP solenoid valve, the oil from the main gallery will flow into the oil pan through the VOP solenoid valve. Therefore, the pressure (F2) which compresses the spring will be lost and the slide will move by the force from the released spring. Then the oil pressure will increase by the changed volume ratio due to the reduced the gap between the rotor and the slide.

Modification basis	
Application basis	
Affected VIN	

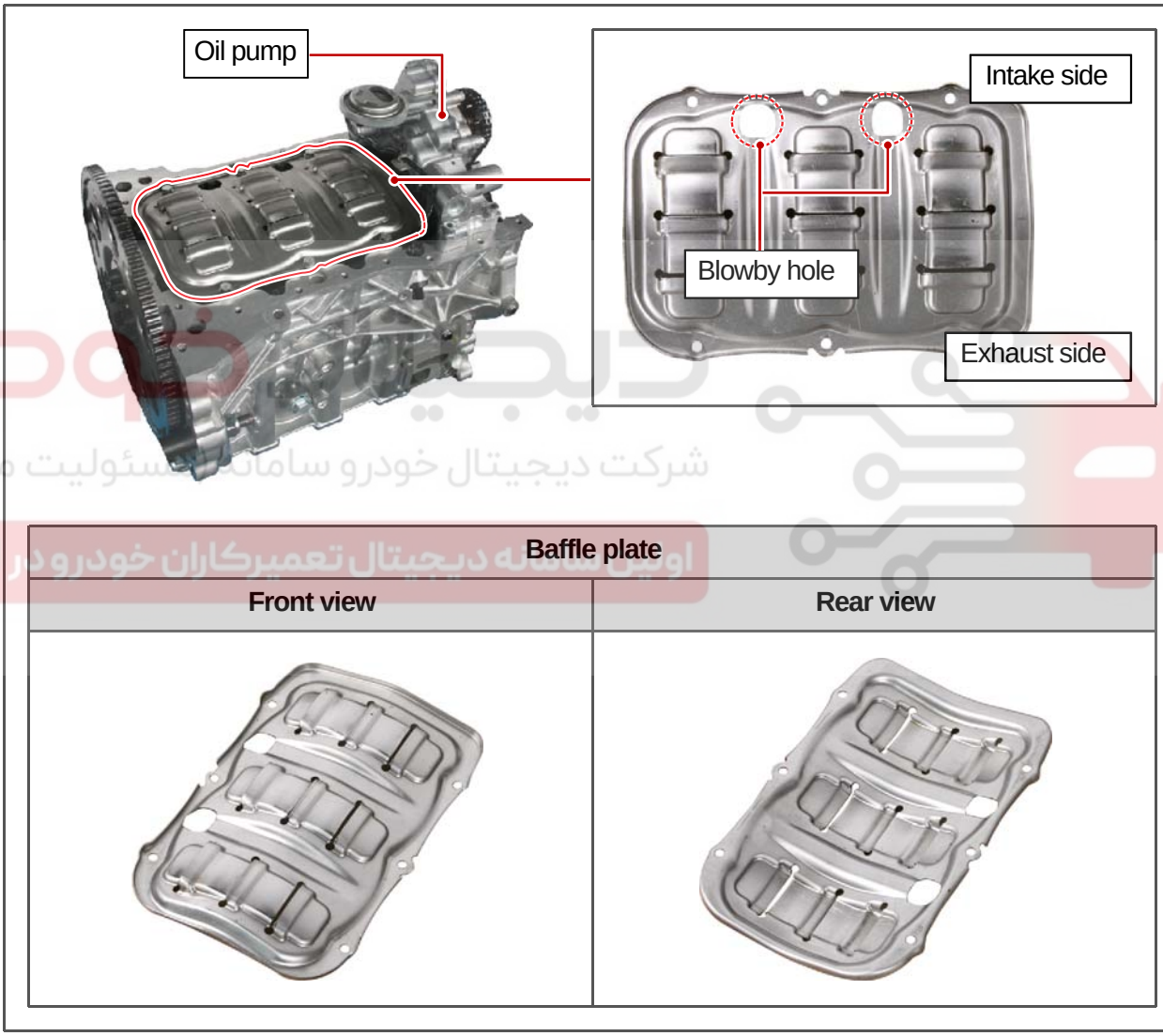
S.G.N. 1538-48

BAFFLE PLATE

1) Overview

The baffle plate is a kind of partition. It is installed in the oil pan. It prevents the oil in the oil pan from sloshing when the vehicle starts off or is stopped. It also prevents the formation of oil bubbles by letting the oil flows down the plate.

2) Mounting Location and Components



Baffle plate	
Front view	Rear view

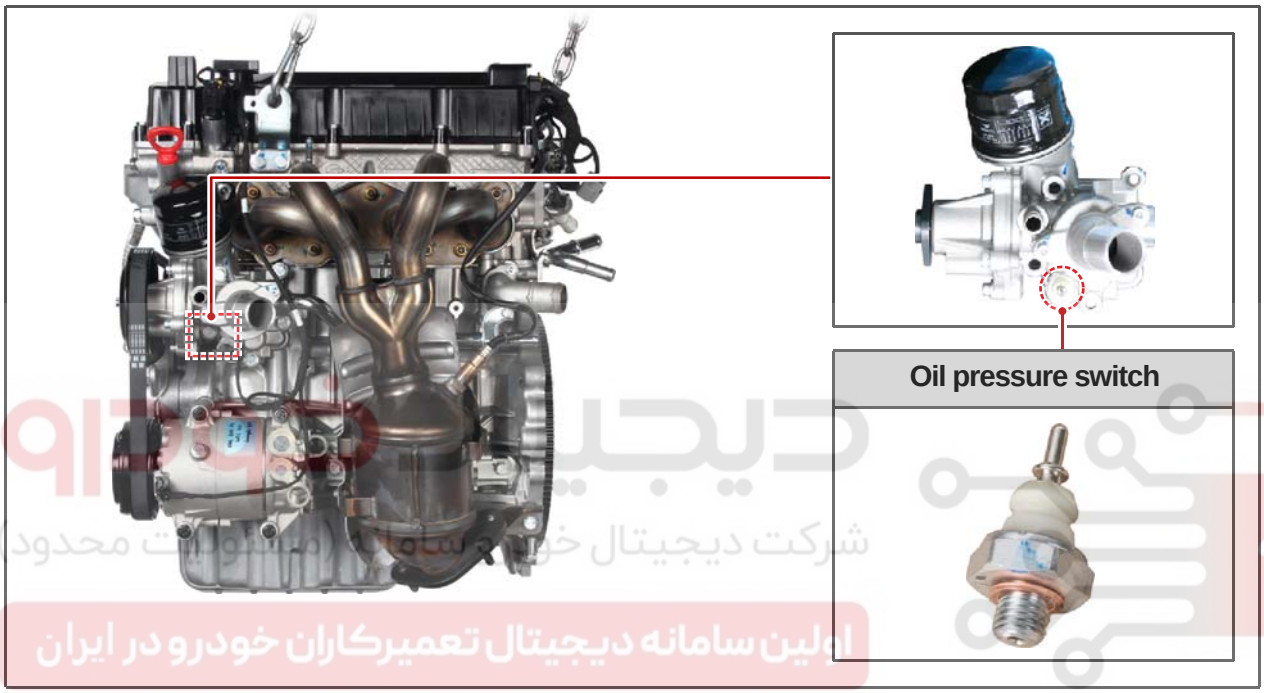
S.G.N. 1548-35

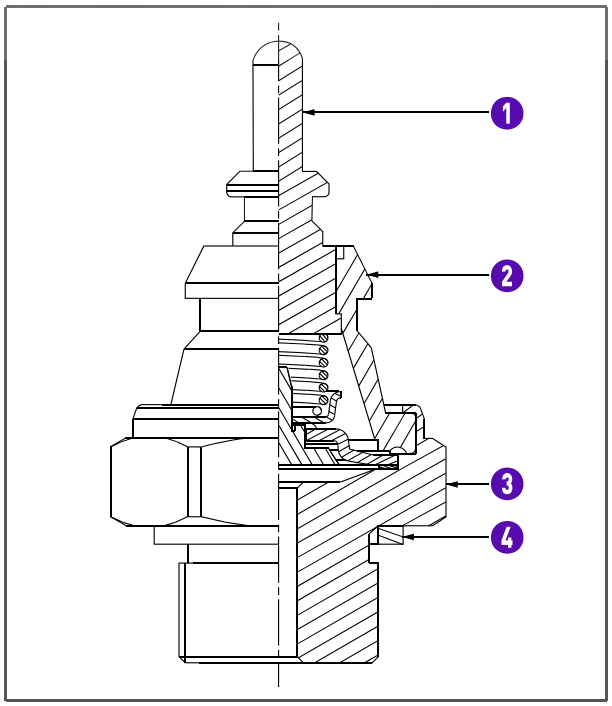
OIL PRESSURE SWITCH

1) Overview

The oil pressure switch is located on the bottom of the oil filter module to detect the oil pressure. If the oil pressure drops below 0.5 bar, the oil warning lamp on the instrument cluster will illuminate.

2) Mounting Location and Components

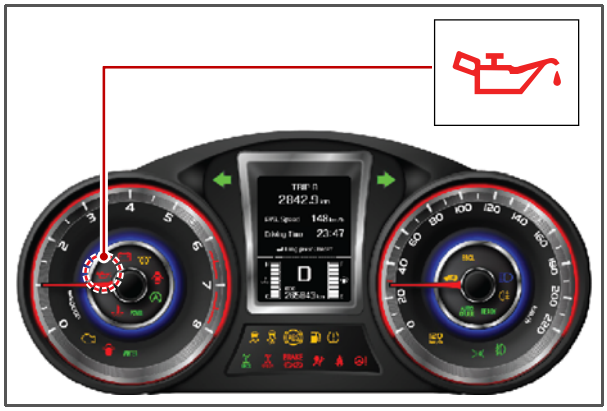




1. Adapter
2. Base
3. Seal washer
4. Body

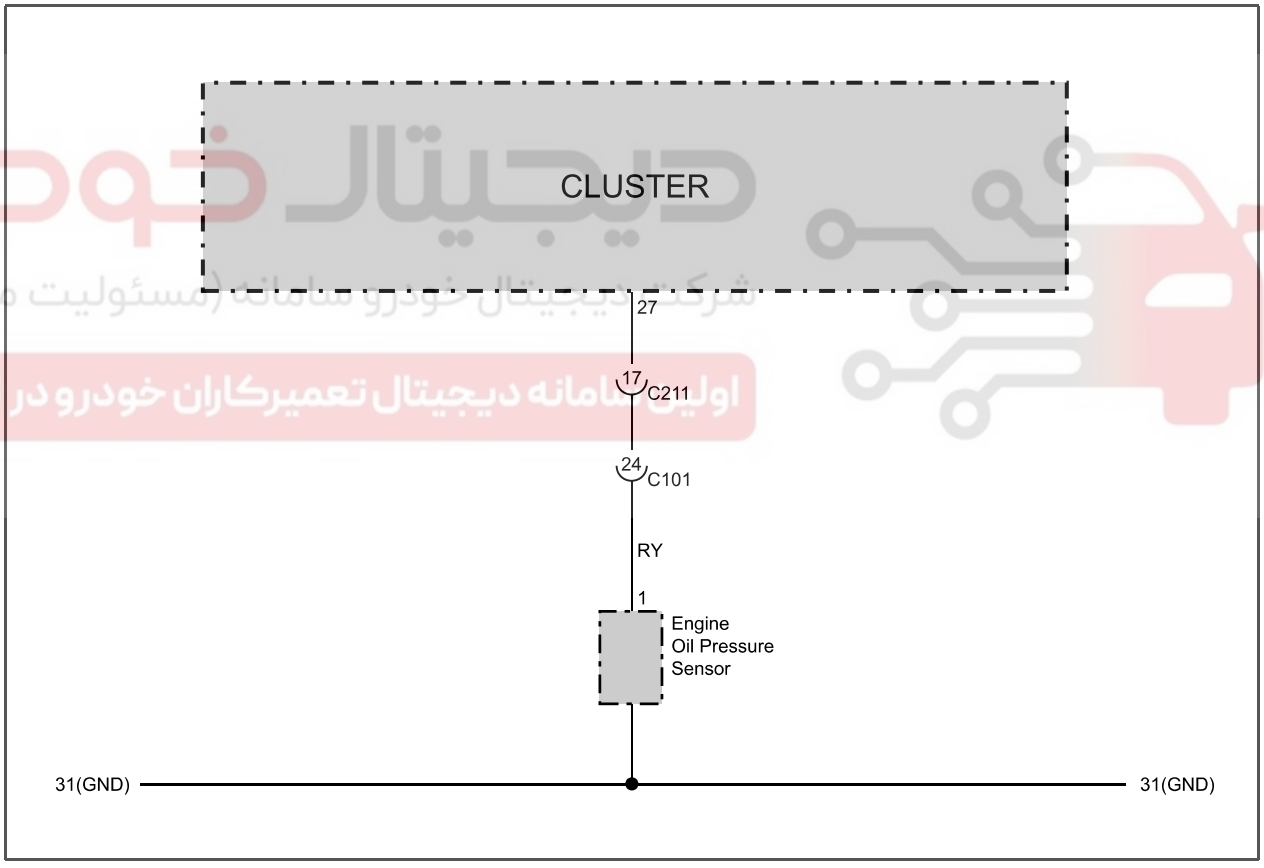
Modification basis	
Application basis	
Affected VIN	

3) Oil Warning Lamp Comes On When



- Low engine oil level
- Faulty engine oil pressure switch
- Insufficient circulation of engine oil (oil filter or oil passage clogged)
- Oil pump stuck

4) Circuit Diagram



REMOVAL AND INSTALLATION

S.G.N. 0000-00 CHECK AND INSPECTION

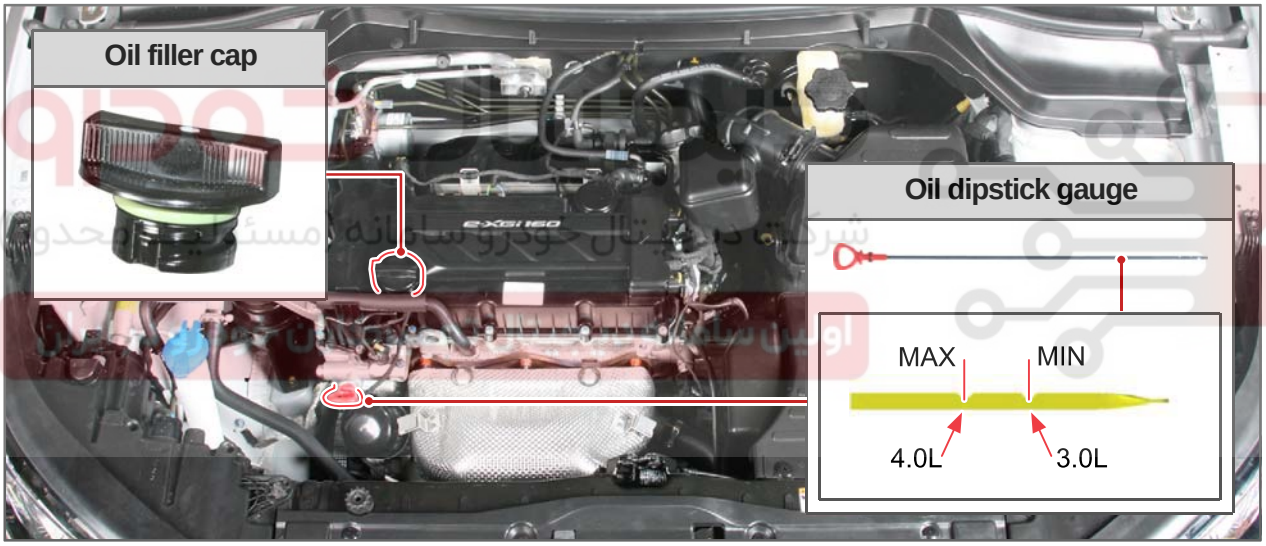
1) Engine Oil

Check the engine oil frequently. Park the vehicle on a level ground and turn off the engine and wait for at least 5 minutes.

- Remove the oil dipstick gauge, and wipe it clean with a cloth. Reinsert it into the dipstick tube.
- Pull it out again and check the oil level.
- The oil level should be between the lower mark (Min) and the upper mark (Max) on the oil dipstick gauge. Add oil before the oil level drops below MIN mark.

WARNING

Operating vehicle with insufficient amount of engine oil can cause severe damage to the engine. Make sure that the engine oil level is within the specified range and add oil, if necessary.



2) Adding Oil

Open the filler cap on top of the engine and add genuine oil.
Wait for 5 minutes and re-check the oil level.

CAUTION

- The engine oil will be used up. To improve the durability of the engine, regularly check the engine oil level and add Ssangyong genuine engine oil, if necessary.
- Clean the dipstick gauge with a clean cloth so that any foreign materials cannot get into the engine. Do not add engine oil to above the MAX mark on the oil dipstick gauge.
- The amount of engine oil consumption increases especially right after the vehicle delivery and
- changing the engine.

Modification basis	
Application basis	
Affected VIN	

S.G.N. 9210-01 CHANGING ENGINE OIL AND OIL FILTER

NOTE

Engine oil and filter service interval

- When changing engine oil
- After 15,000 km of driving (Initial 10,000 km of driving)
- 12 months after previous replacement

CAUTION

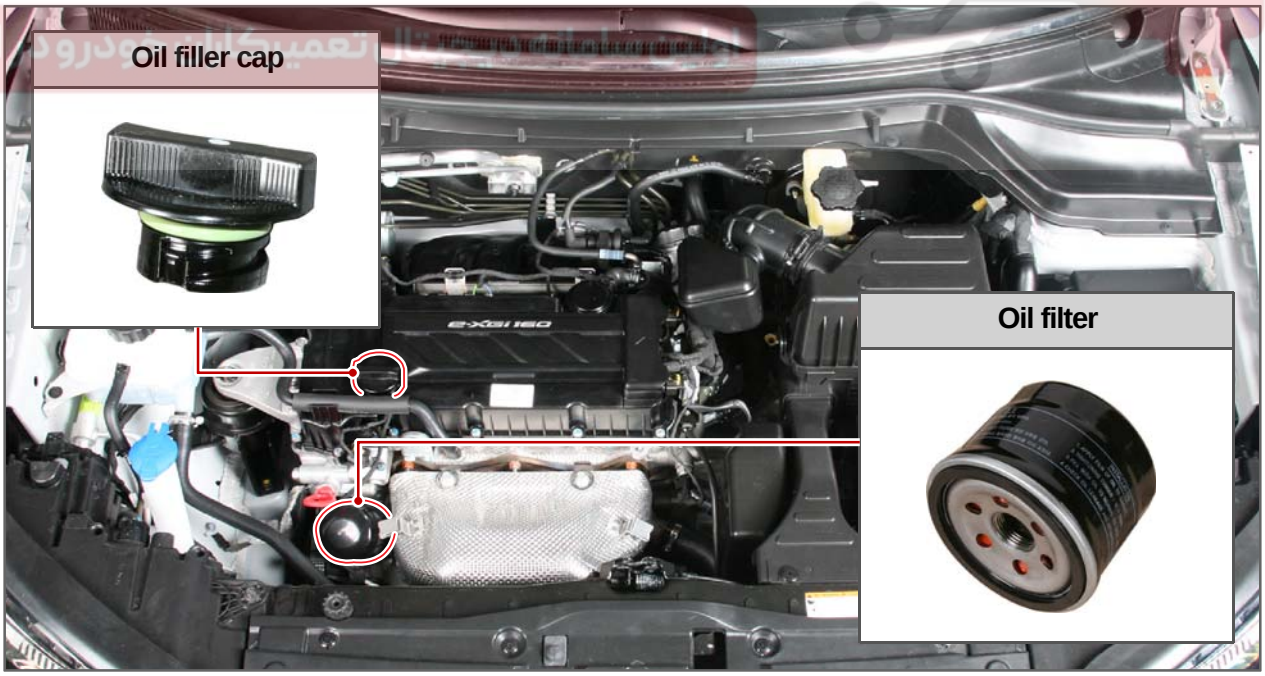
Replace the oil filter when changing the engine oil.

- Regularly check the engine oil level and add oil, if necessary.
- Service more frequently under severe conditions.

Sever conditions

- Frequent stop-and-go
- Short driving distance less than 6 km
- Driving distance less than 16 km when the outside temperature remains below the freezing point
- Frequent steep hills
- Driving on sandy, dusty or coastal area
- High load

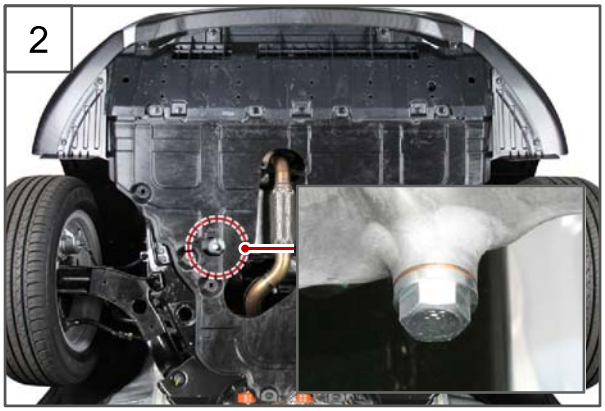
1. Remove the oil filler cap from the engine compartment.



NOTE

When changing the oil filter only, open the oil filler cap and wait for at least 5 minutes.

2

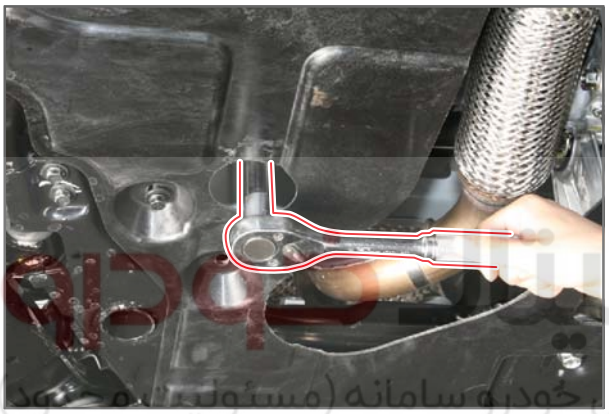


2. Unscrew the oil pan drain plug (14 mm) under the vehicle to drain the engine oil. Fit the drain plug after the oil has been drained completely.

Tightening torque 27 to 33 Nm

CAUTION

- Tighten the drain plug to the specified torque. Otherwise, there is a risk of oil leakage.
- Replace the washer for the drain plug with a new one.



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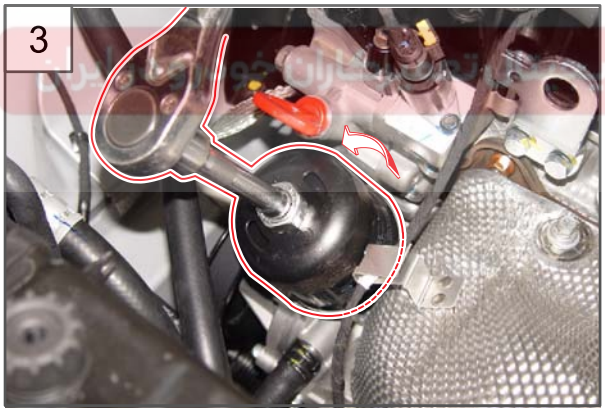


3. Loosen the oil filter in the engine compartment with an oil filter removal/installation cup by turning it counterclockwise.

Tightening torque 12 to 16 Nm

4

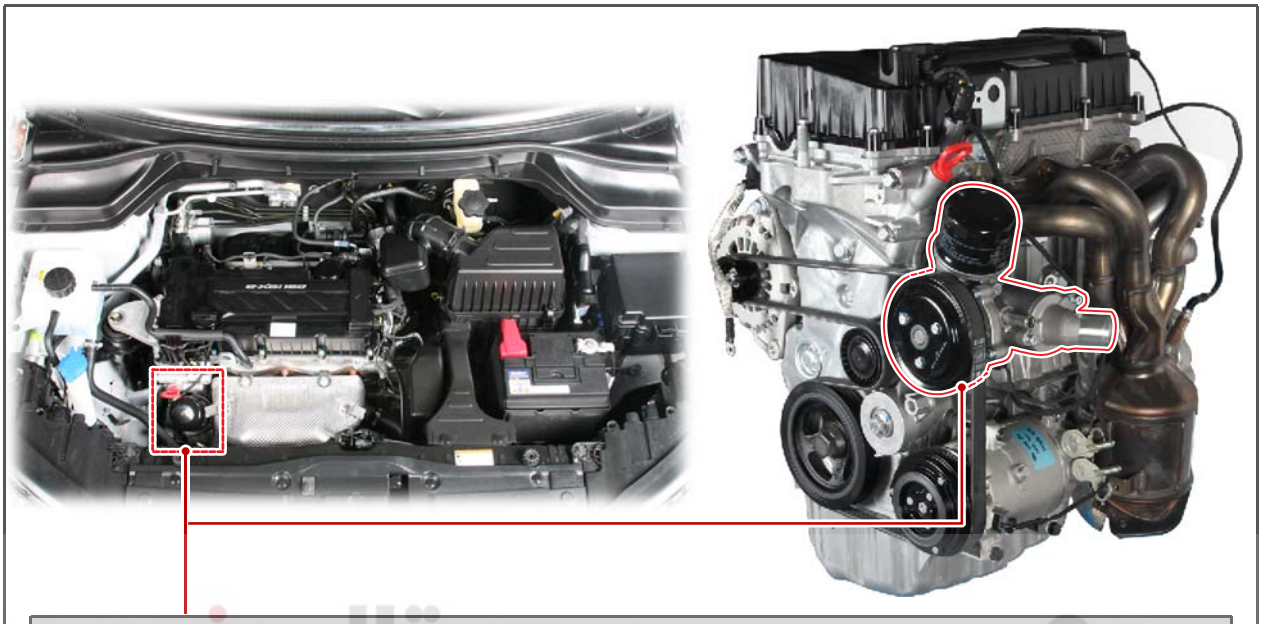
4. Remove the oil filter and replace it with a new one.
5. Add oil through the oil filler and fit the oil filler cap.

Modification basis	
Application basis	
Affected VIN	

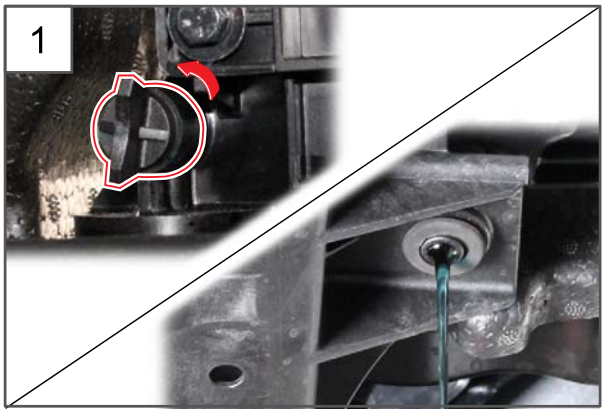
S.G.N. 1548-01

OIL FILTER MODULE

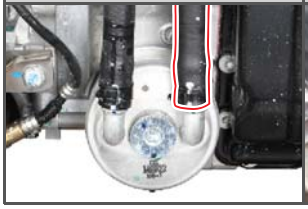
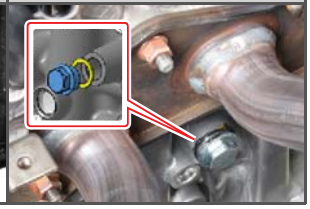
Preceding work - Disconnect the negative battery cable.



Oil filter module



1. Drain the coolant. Refer to "COOLANT DRAIN AND FILL UP" under "REMOVAL AND INSTALLATION" subsection of "COOLING SYSTEM" section in "G16DF ENGINE" chapter.

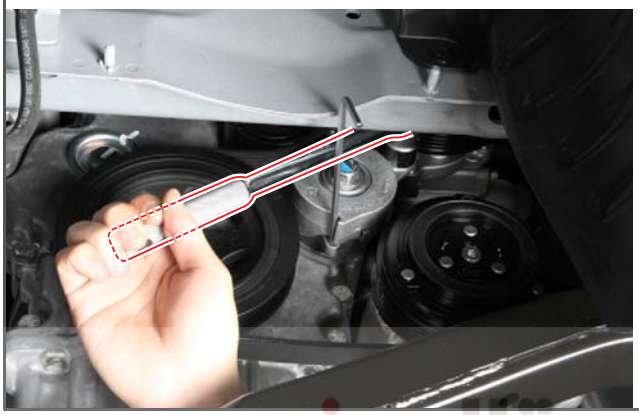
For vehicle with A/T	For vehicle with M/T
	

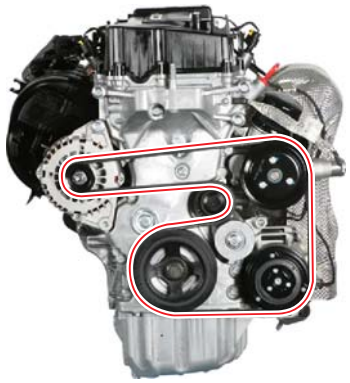
Modification basis	
Application basis	
Affected VIN	

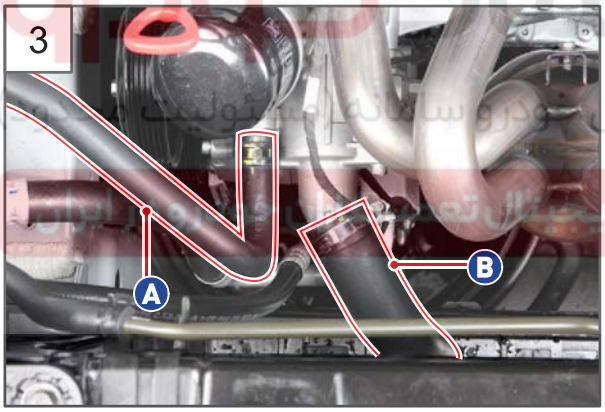
2. Remove the fan belt from the vehicle.

NOTE

Refer to "BELT SYSTEM" under "REMOVAL AND INSTALLATION" subsection of "ENGINE ASSEMBLY" section in "G16DF ENGINE" chapter.







3. Remove the 2 spring clamps (7 mm) and disconnect the make up hose (A) and the radiator outlet hose (B) from the oil filter module.

Tightening torque 6 to 7 Nm

Modification basis	
Application basis	
Affected VIN	

4. Remove the TOC coolant return pipe (for a vehicle with A/T) or coolant return pipe (for a vehicle with M/T).

4

NOTE

- For a vehicle with A/T, refer to "TOC COOLANT RETURN PIPE" under "REMOVAL AND INSTALLATION" subsection of "COOLING SYSTEM" section in "G16DF ENGINE" chapter.
- For a vehicle with M/T, refer to "COOLANT RETURN PIPE" under "REMOVAL AND INSTALLATION" subsection of "COOLING SYSTEM" section in "G16DF ENGINE" chapter.

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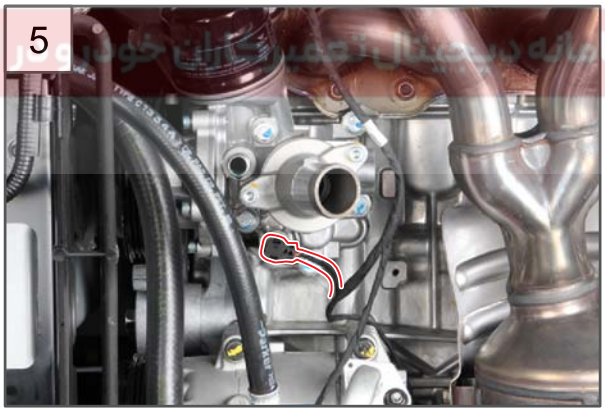
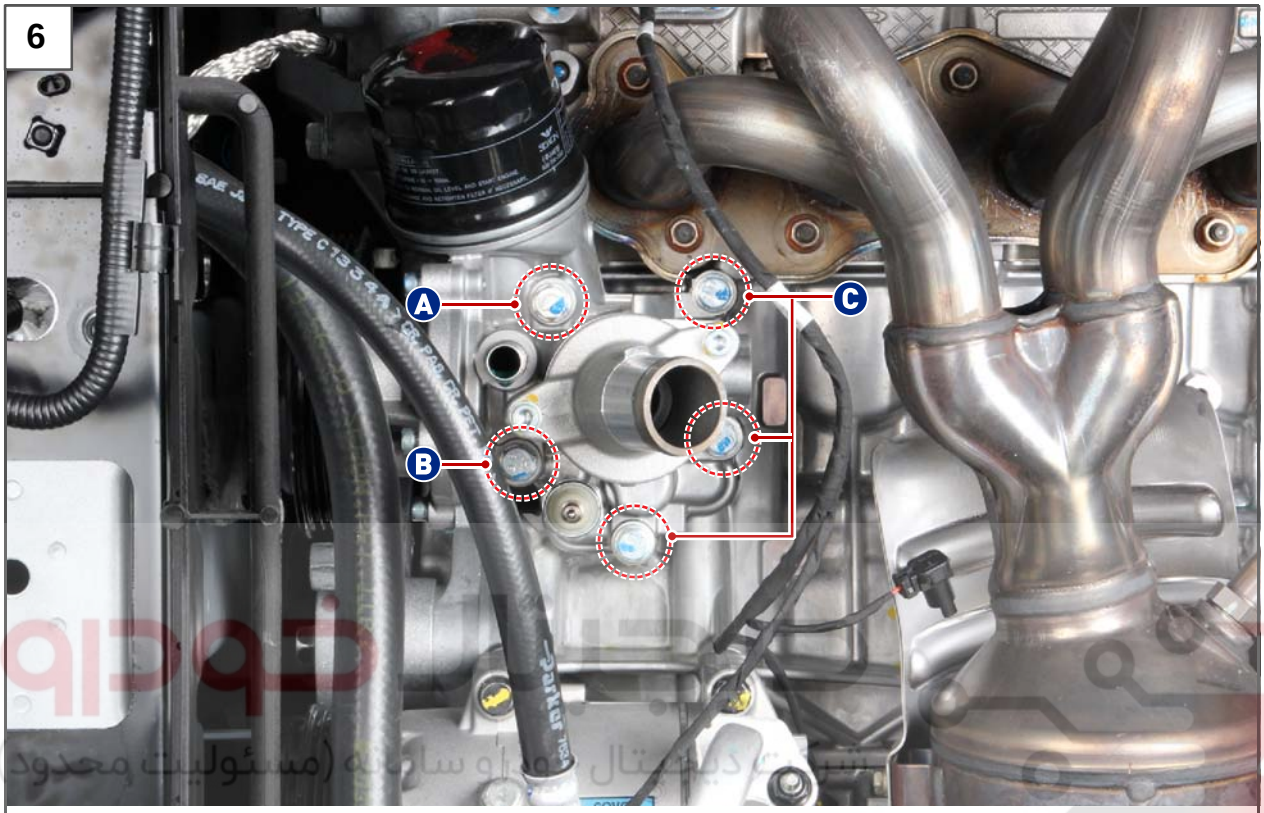


5. Disconnect the oil pressure switch connector from the underside of the thermostat.

6. Unscrew the 5 mounting bolts (13 mm) for the oil filter module.



No.	Tool dimensions (mm)	Bolt length (mm)	Quantity	Tightening torque
A	13	60	1	25 ± 2.5 Nm
B		105	1	
C		40	3	

Modification basis	
Application basis	
Affected VIN	

7

7. Remove the oil filter module.

CAUTION

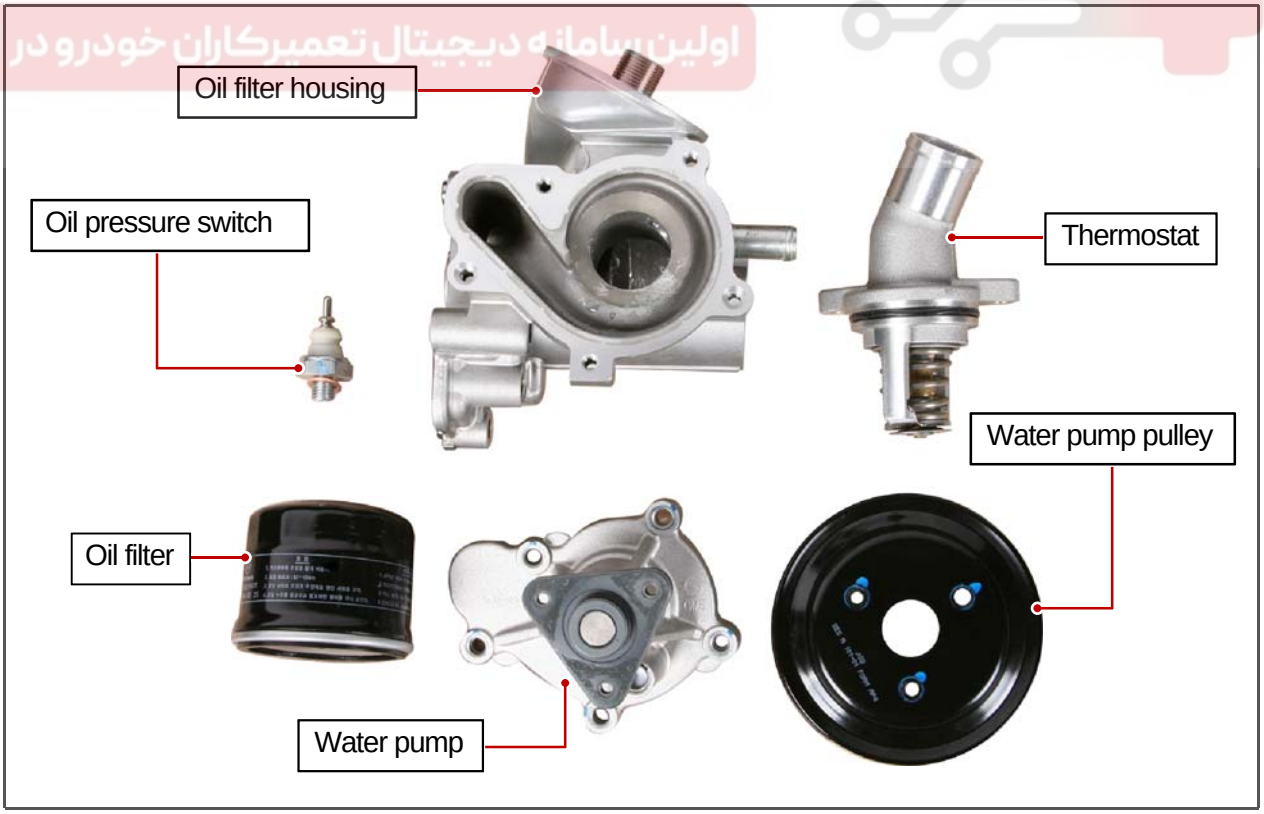
Be careful not to damage the oil dipstick gauge when removing the oil filter module.

8

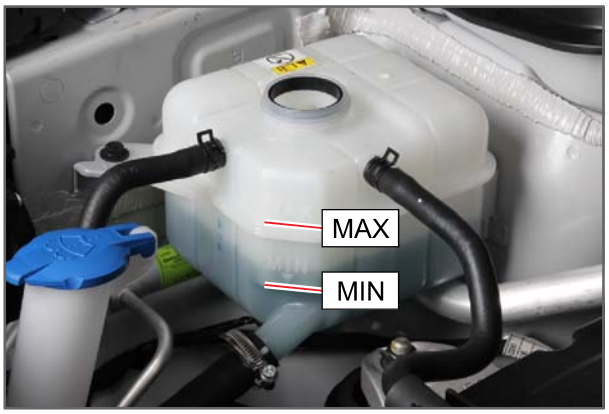
8. Install in the reverse order of removal.

NOTE

Replace the oil filter module gasket with a new one.



Modification basis	
Application basis	
Affected VIN	



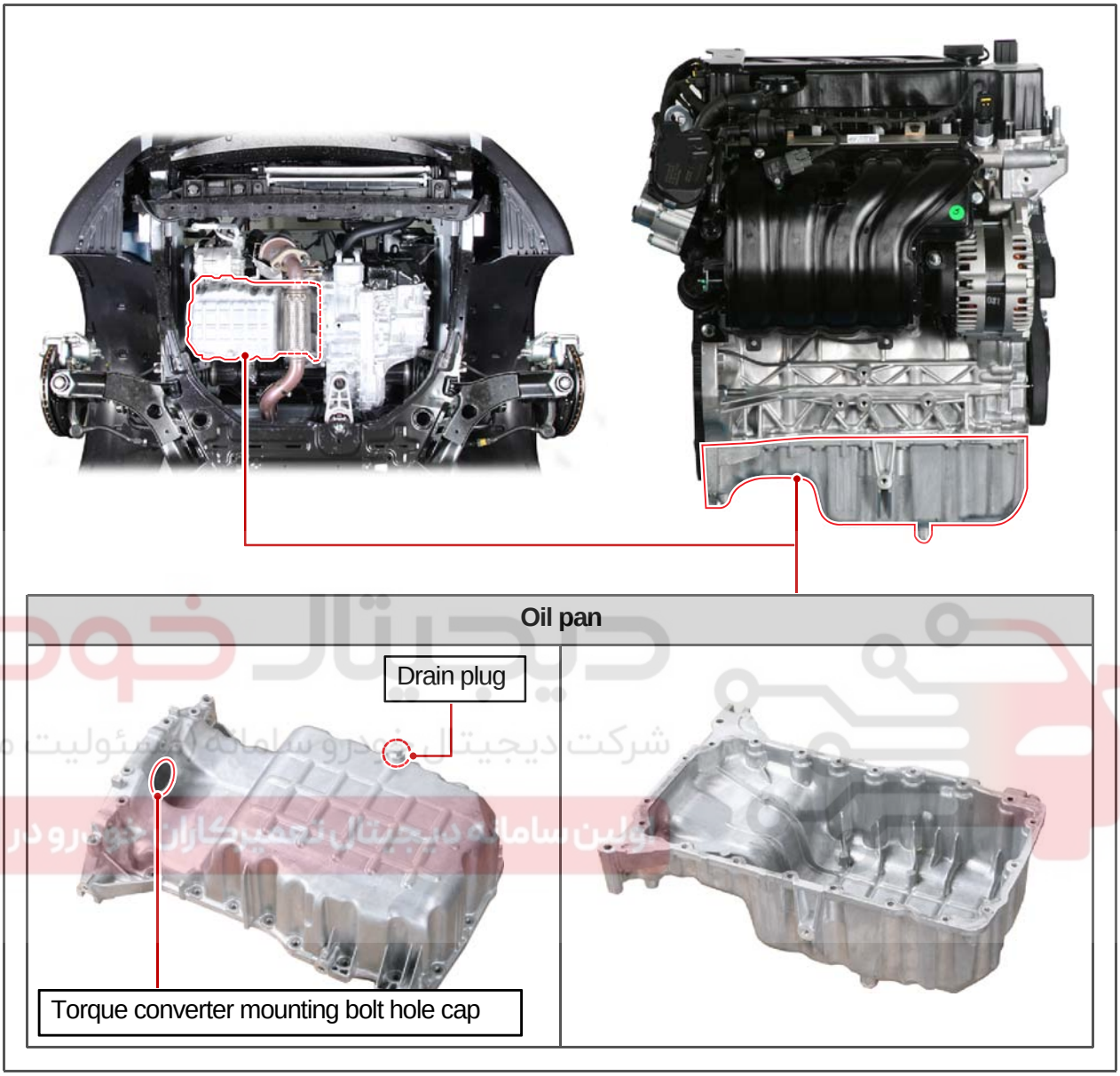
NOTE

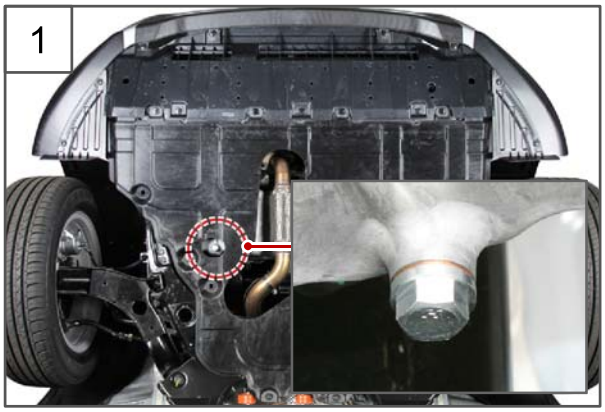
- Install the oil filter module and fill the coolant reservoir tank with the coolant.
- Fit the coolant reservoir tank pressure cap. After warming up the engine (thermostat open), check if the coolant level reaches to the MAX mark. If not, refill the coolant. (within 10 mm in relation to MAX mark)

Modification basis	
Application basis	
Affected VIN	

S.G.N. 1538-08

OIL PAN





1. Unscrew the oil drain plug (14 mm) under the vehicle to drain the engine oil.

Tightening torque 27 to 33 Nm

CAUTION

- Tighten the drain plug to the specified torque. Otherwise, there is a risk of oil leakage.
- Replace the washer for the drain plug with a new one.

Modification basis	
Application basis	
Affected VIN	

2

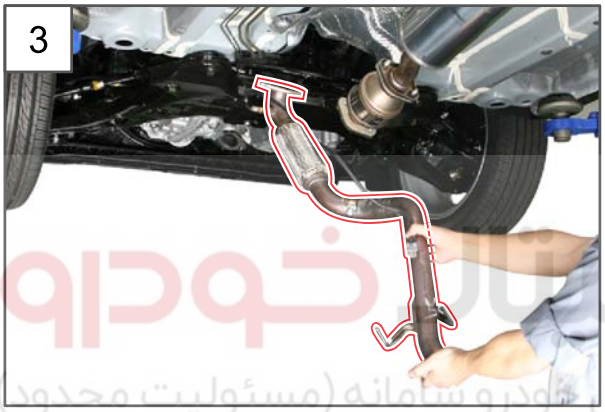
2. Remove the rear under cover under the vehicle.

Tightening torque 13.8 to 17.6 Nm

CAUTION

Tighten the mounting bolt to the specified torque. Excessive tightening torque can cause damage to the rear under cover.

3



3. Remove the front exhaust pipe.

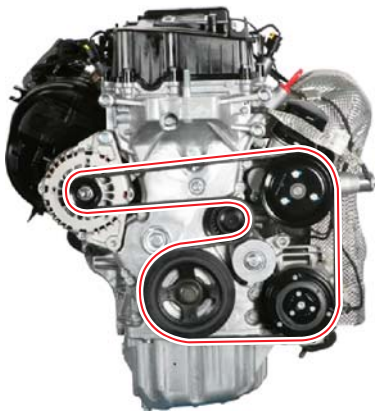
NOTE

Refer to "FRONT EXHAUST PIPE" under "REMOVAL AND INSTALLATION" subsection of "EXHAUST SYSTEM" section in "G16DF ENGINE" chapter.

4. Remove the fan belt before removing the oil pan. Otherwise, the A/C compressor can be damaged by the tension of the fan belt when unscrewing the mounting bolts (A) located on the bottom of the compressor.

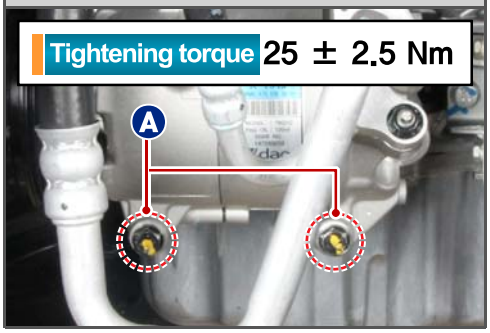
NOTE

Refer to "BELT SYSTEM" under "REMOVAL AND INSTALLATION" subsection of "ENGINE ASSEMBLY" section in "G16DF ENGINE" chapter.



Mounting bolts on the bottom of A/C compressor (13 mm, 2 off)

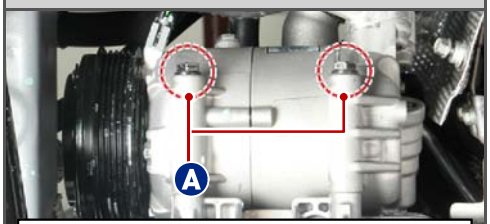
Tightening torque 25 ± 2.5 Nm



Modification basis	
Application basis	
Affected VIN	

5. Unscrew the mounting bolts (A), (B), (C), and (D) for the oil pan.

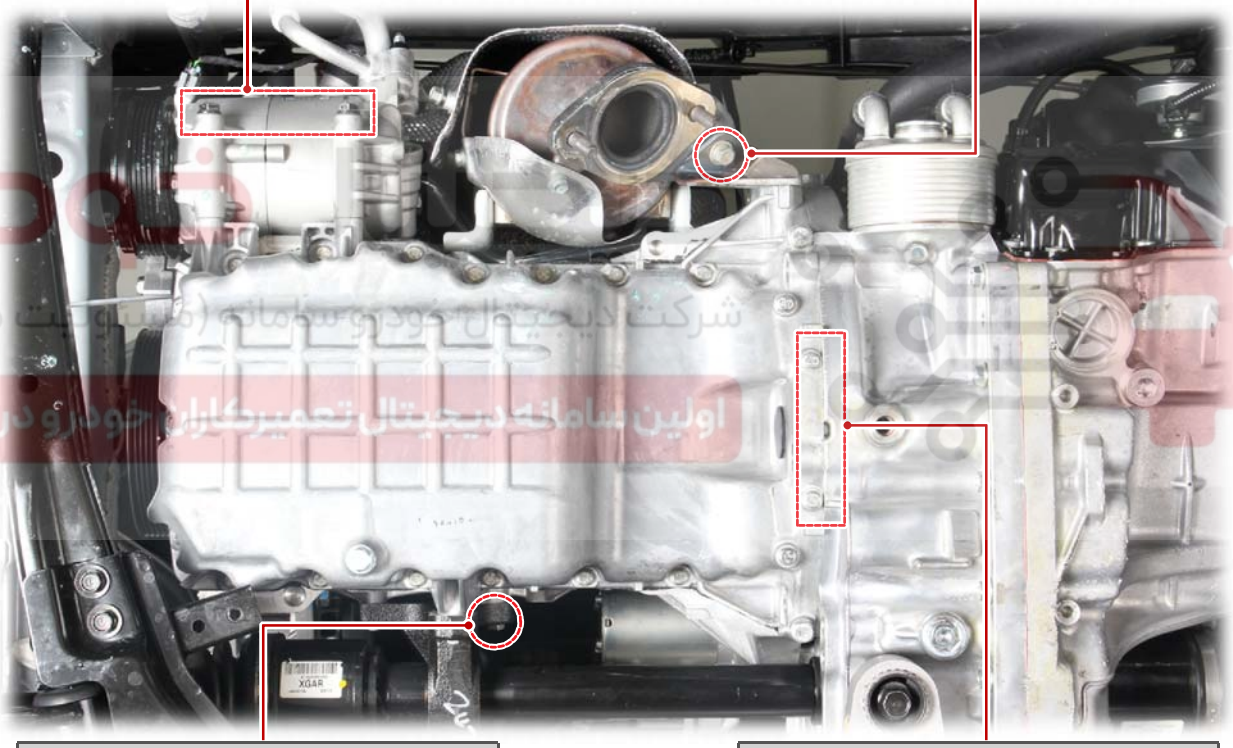
Mounting bolts on the bottom of A/C compressor (13 mm, 2 off)



Tightening torque 25 ± 2.5 Nm

Mounting bolt on the exhaust manifold (13 mm)

Tightening torque 25 ± 2.5 Nm

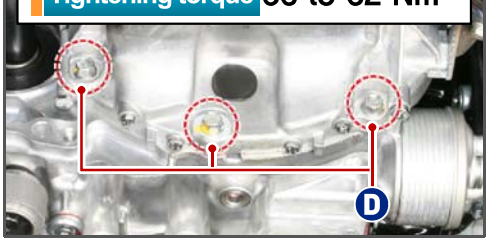


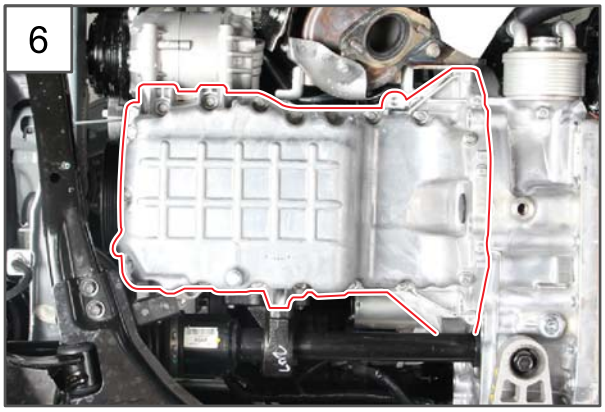
Mounting bolt on the intermediate shaft (12 mm)

Tightening torque 24.5 to 29.4 Nm

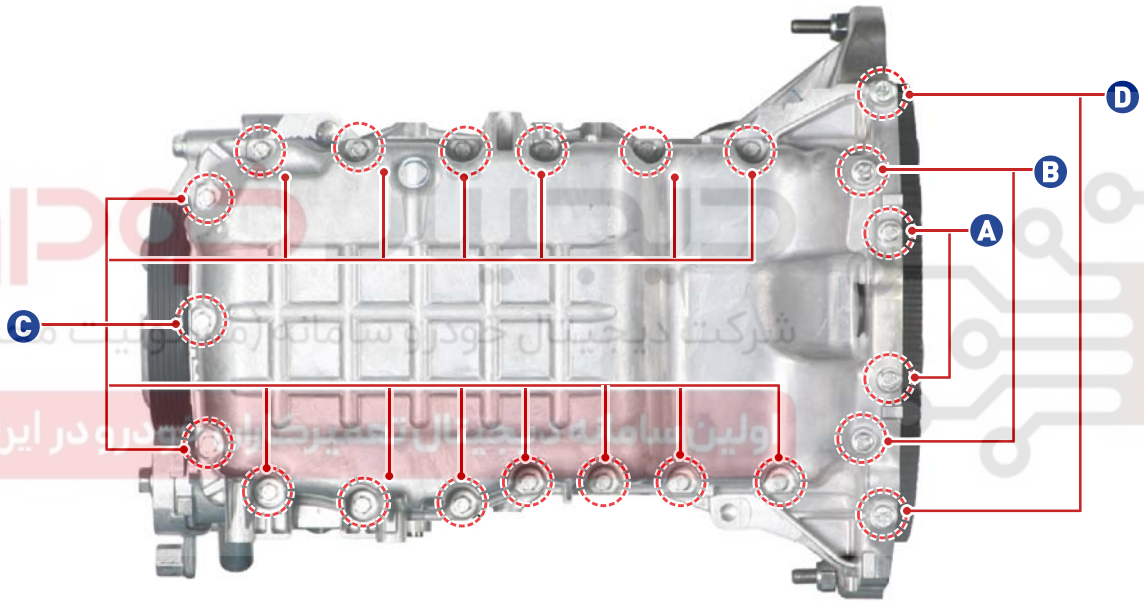
Mounting bolts securing the oil pan and transmission (14 mm, 3 off)

Tightening torque 56 to 62 Nm





6. Unscrew the mounting bolts (A), (B), (C), and (D) for the oil pan from the underside of the engine assembly.



No.	Tool dimensions (mm)	Bolt length (mm)	Quantity	Tightening torque
A	10	115	2	10 ± 1.0 Nm
B		105	2	
C		25	16	
D	13	80	2	25 ± 2.5 Nm

CAUTION

To protect the oil pan from damage, remove the bolts in sequence as follows:
- When removing: from the outside to the inside, diagonally
- When installing: from the center to the outside, diagonally

Modification basis	
Application basis	
Affected VIN	

7

7. Pry off the oil pan by inserting a flat-bladed screwdriver into the gap between the oil pan and A/C compressor.

8

8. Remove the oil pan from the vehicle.

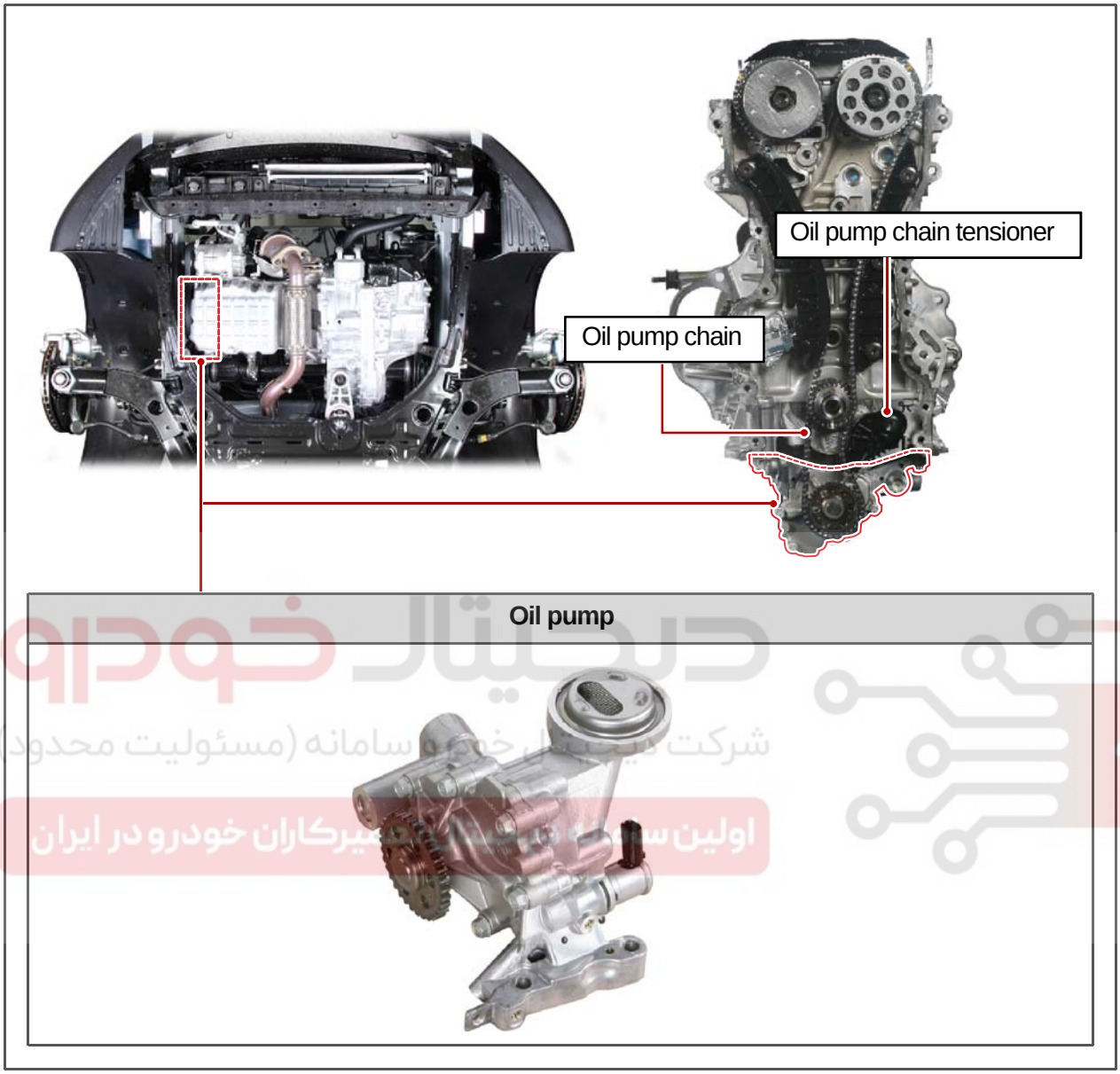
9. Install in the reverse order of removal.

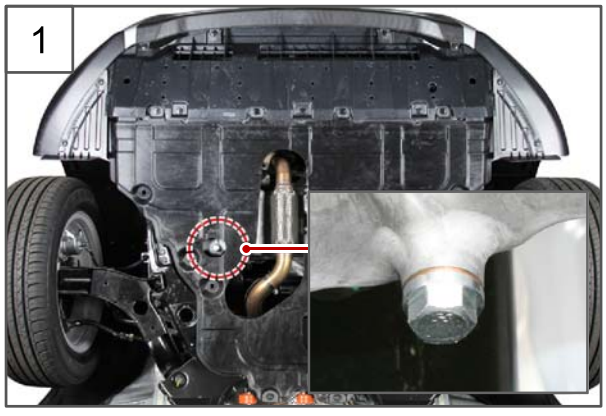
NOTE

Apply sealant to the oil pan before fitting it. (sealant part No.: 661 989 56 A0)

S.G.N. 1538-01

OIL PUMP





1. Unscrew the oil drain plug (14 mm) under the vehicle to drain the engine oil.

Tightening torque 27 to 33 Nm

CAUTION

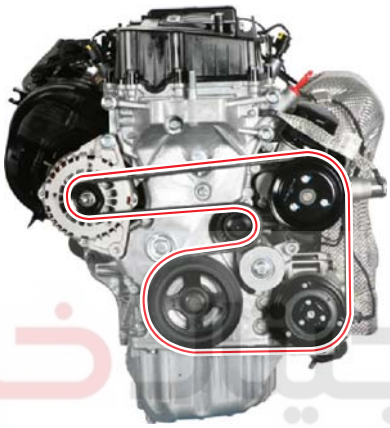
- Tighten the drain plug to the specified torque. Otherwise, there is a risk of oil leakage.
- Replace the washer for the drain plug with a new one.

Modification basis	
Application basis	
Affected VIN	

2. Remove the fan belt before removing the oil pan. Otherwise, the A/C compressor can be damaged by the tension of the fan belt when unscrewing the mounting bolts (A) located on the bottom of the compressor.

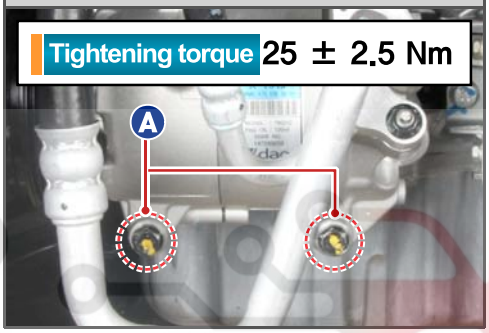
NOTE

Refer to "BELT SYSTEM" under "REMOVAL AND INSTALLATION" subsection of "ENGINE ASSEMBLY" section in "G16DF ENGINE" chapter.

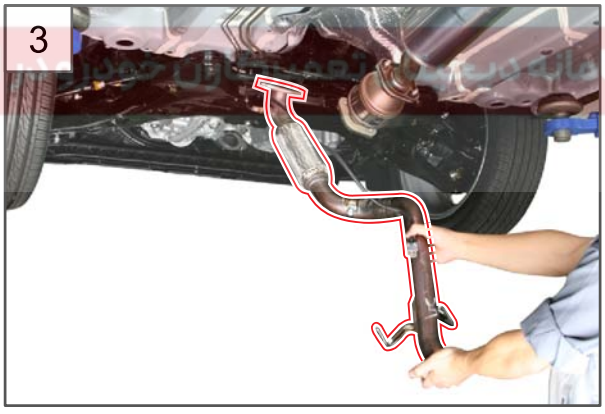


Mounting bolts on the bottom of A/C compressor (13 mm, 2 off)

Tightening torque 25 ± 2.5 Nm



3



3. Remove the front exhaust pipe.

NOTE

Refer to "FRONT EXHAUST PIPE" under "REMOVAL AND INSTALLATION" subsection of "EXHAUST SYSTEM" section in "G16DF ENGINE" chapter.

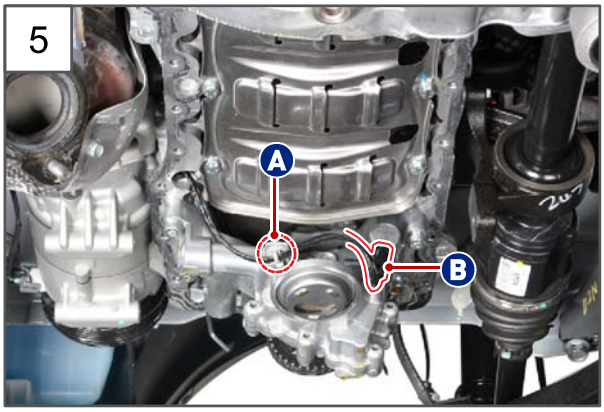
4

4. Remove the oil pan from the vehicle.

NOTE

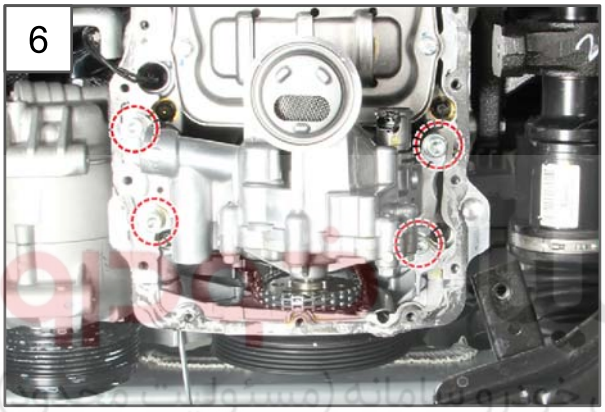
Refer to "OIL PAN" under "REMOVAL AND INSTALLATION" subsection of "LUBRICATION SYSTEM" section in "G16DF ENGINE" chapter.

5



5. Disengage the VOP extension wiring clamp (A) and disconnect the VOP solenoid connector (B) from the oil pump.

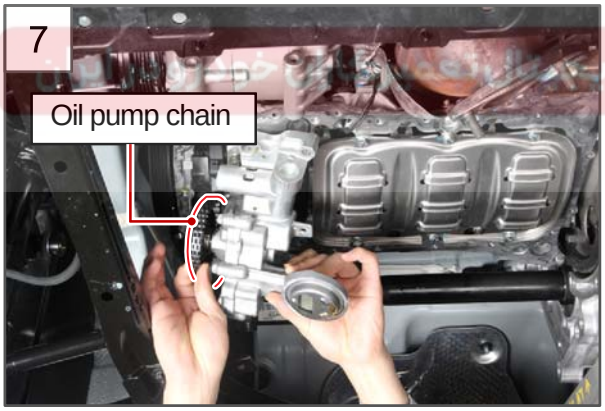
6



6. Unscrew the 4 hexagon mounting bolts (6 mm) for the oil pump.

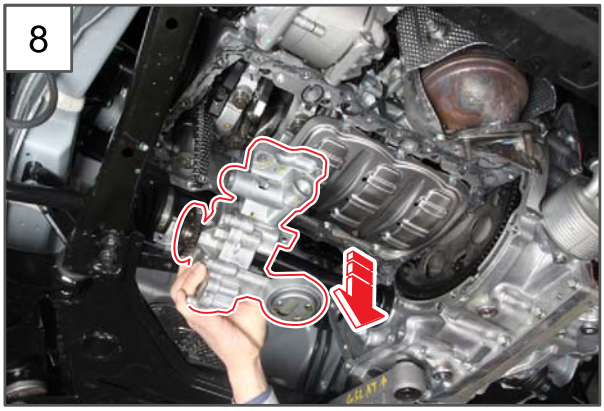
Tightening torque 25 ± 2.5Nm

7



7. Separate the oil pump from the oil pump chain.

8



8. Remove the oil pump.

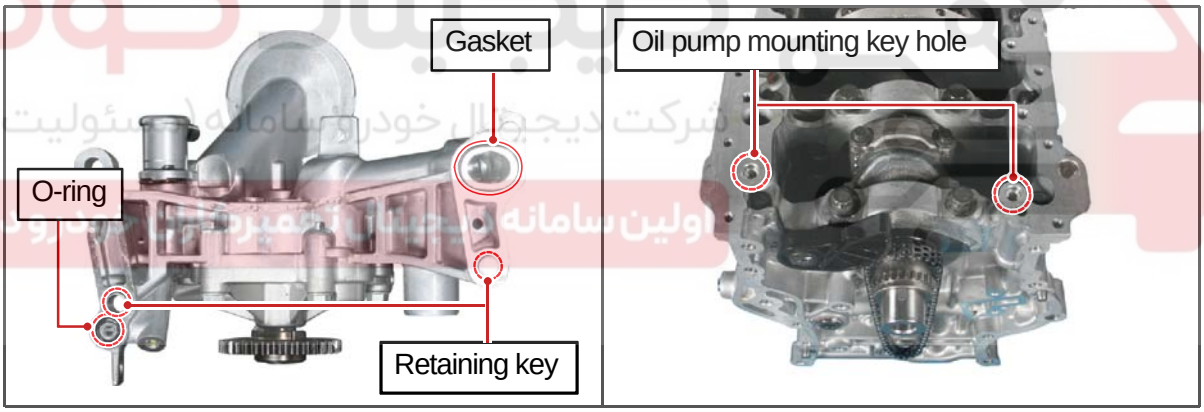
Modification basis	
Application basis	
Affected VIN	

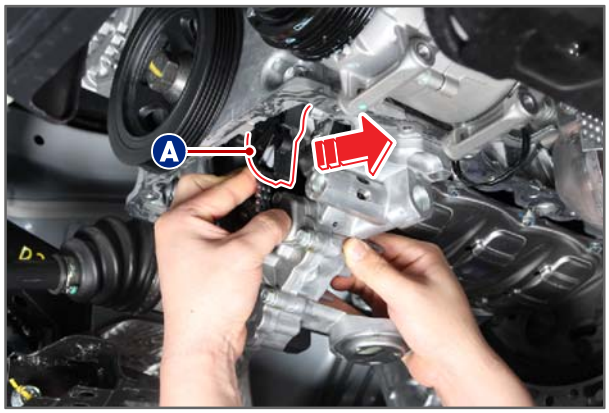
9

9. Install in the reverse order of removal.

Cautions for fitting oil pump

- Always replace the O-ring and gasket located on the rear side of the oil pump with new ones. Make sure that the retaining key on the rear side of the oil pump is fitted correctly to the
- retaining key hole on the surface of the cylinder block.

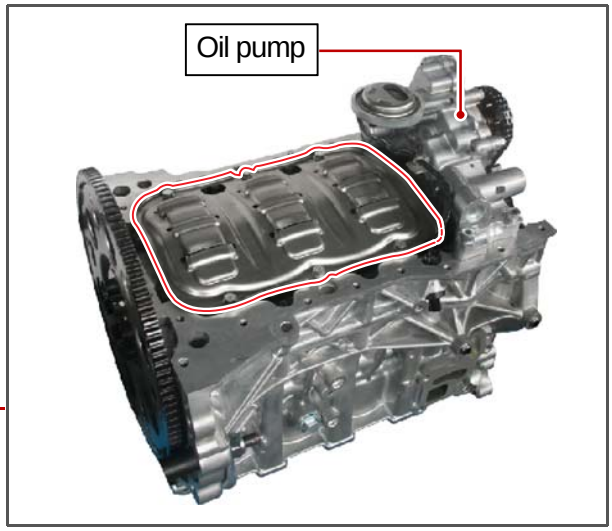


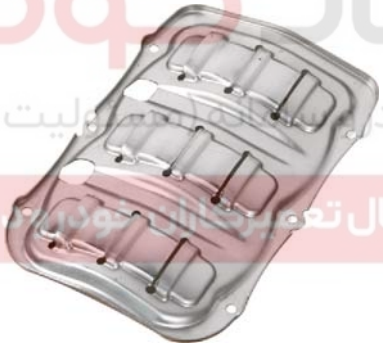


- Install the oil pump to the oil pump chain after pulling the oil pump chain tensioner (A) in the direction of the arrow to release the tension of the oil pump chain.

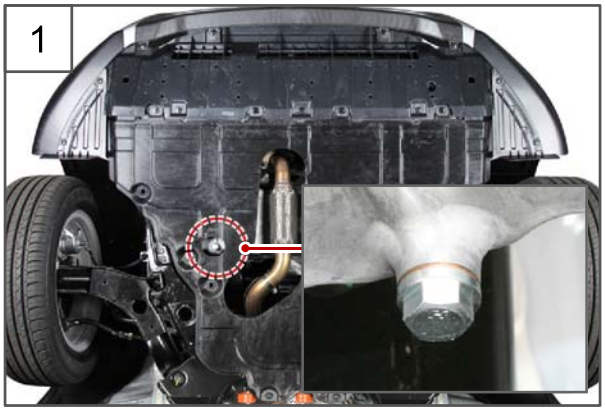
S.G.N. 1538-48

BAFFLE PLATE



Baffle plate	
Front view	Rear view
	

1



1. Unscrew the oil drain plug (14 mm) under the vehicle to drain the engine oil.

Tightening torque 27 to 33 Nm

CAUTION

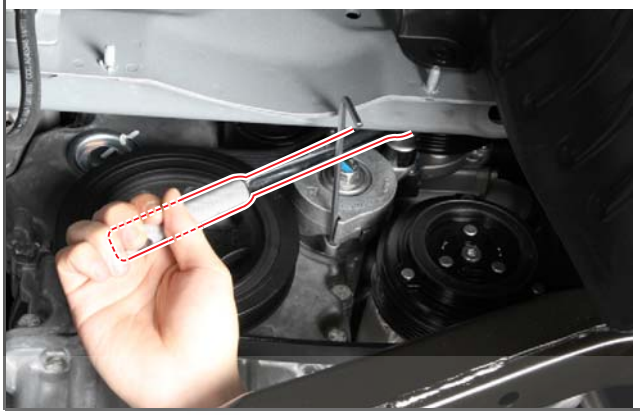
- Tighten the drain plug to the specified torque. Otherwise, there is a risk of oil leakage.
- Replace the washer for the drain plug with a new one.

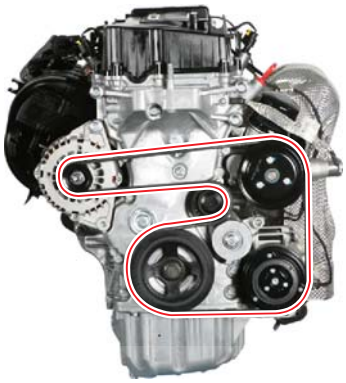
Modification basis	
Application basis	
Affected VIN	

2. Remove the fan belt from the vehicle.

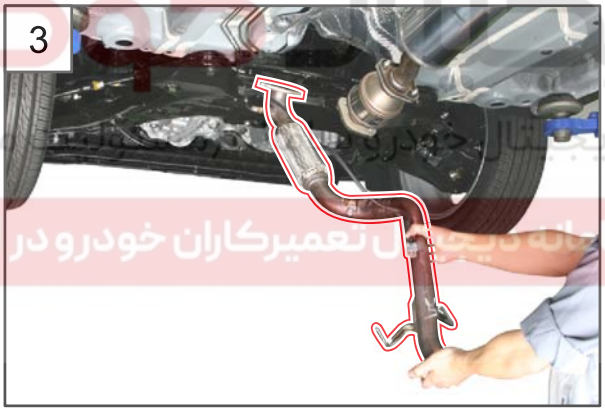
NOTE

Refer to "BELT SYSTEM" under "REMOVAL AND INSTALLATION" subsection of "ENGINE ASSEMBLY" section in "G16DF ENGINE" chapter.





3



3. Remove the front exhaust pipe.

NOTE

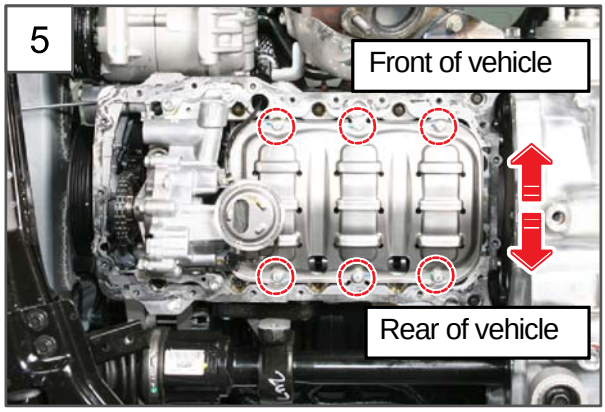
Refer to "FRONT EXHAUST PIPE" under "REMOVAL AND INSTALLATION" subsection of "EXHAUST SYSTEM" section in "G16DF ENGINE" chapter.

4

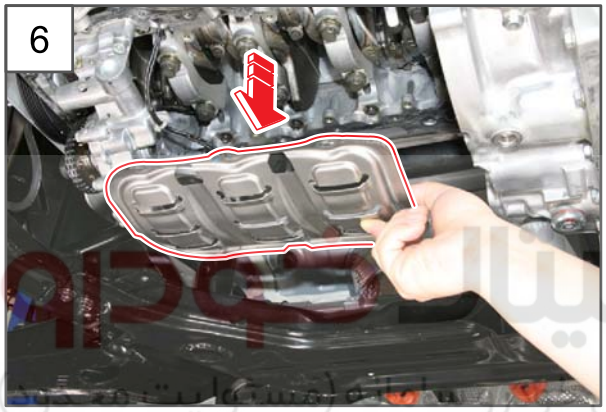
4. Remove the oil pan from the vehicle.

NOTE

Refer to "OIL PAN" under "REMOVAL AND INSTALLATION" subsection of "LUBRICATION SYSTEM" section in "G16DF ENGINE" chapter.



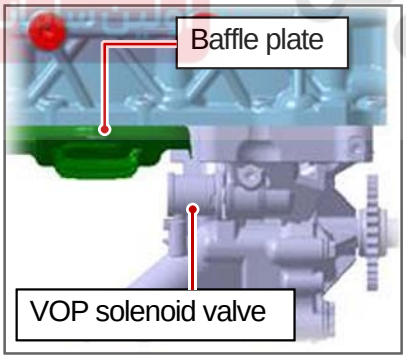
5. Unscrew the 6 mounting bolts (10 mm) for the baffle plate.

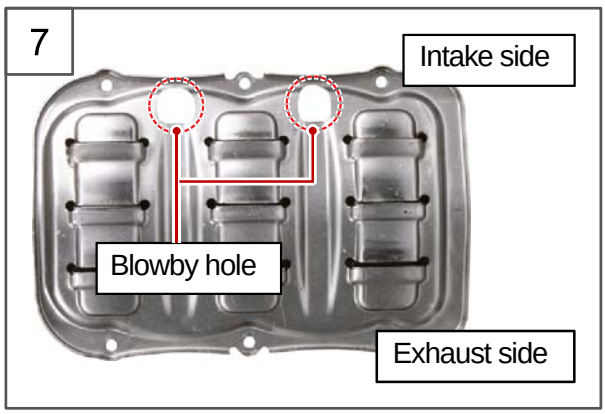


6. Remove the baffle plate.

CAUTION

Make sure that the baffle plate does not interfere with the VOP solenoid valve when removing the baffle plate.





7. Install in the reverse order of removal.

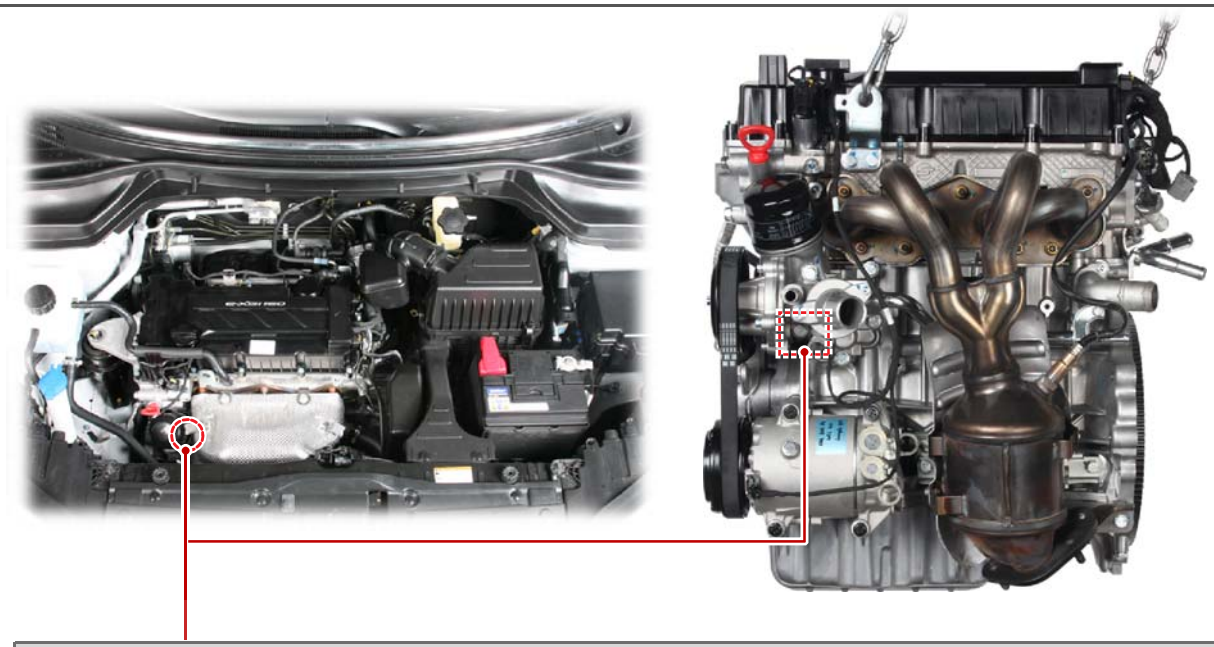
CAUTION

Make sure that the blowby holes of the baffle plate face the intake side.

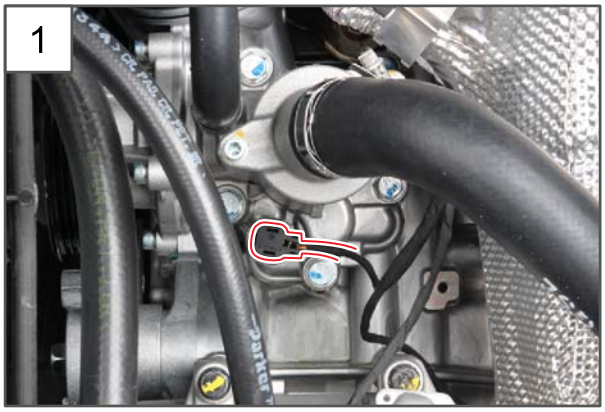
Modification basis	
Application basis	
Affected VIN	

S.G.N. 1548-35

OIL PRESSURE SWITCH



Oil pressure switch



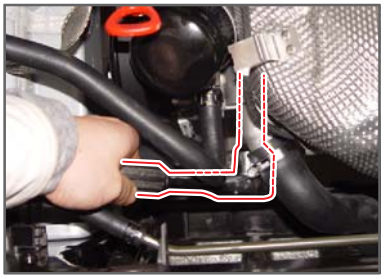
1. Disconnect the oil pressure switch connector from the underside of the thermostat.

Modification basis	
Application basis	
Affected VIN	

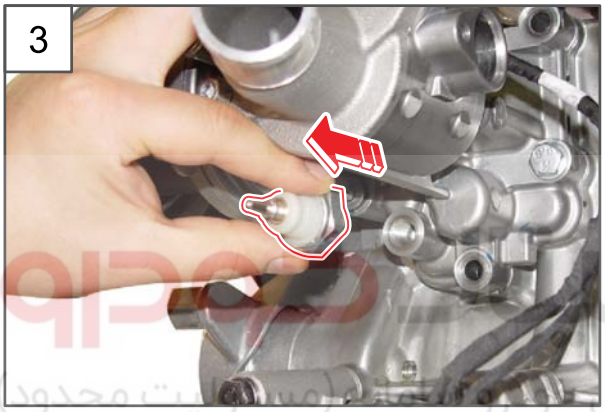
2

2. Turn the oil pressure switch (24 mm) anti-clockwise.

Tightening torque 50 Nm

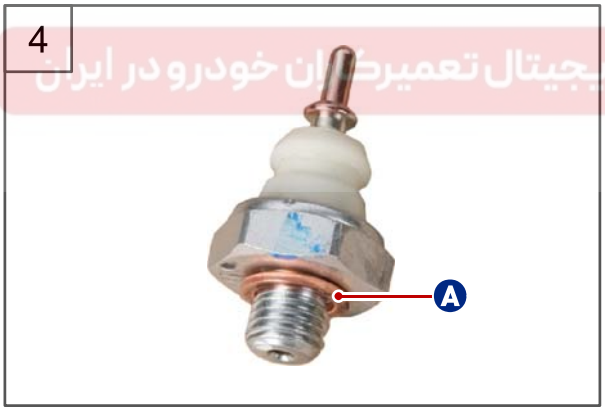


3



3. Remove the oil pressure switch.

4



4. Install in the reverse order of removal.

NOTE

When fitting the oil pressure switch, always replace the washer (A) with a new one.

Modification basis	
Application basis	
Affected VIN	